Applied Baccalaureate Degrees in STEM and Technician Education: Program Implementation in Five Regions of the United States

Technical Report

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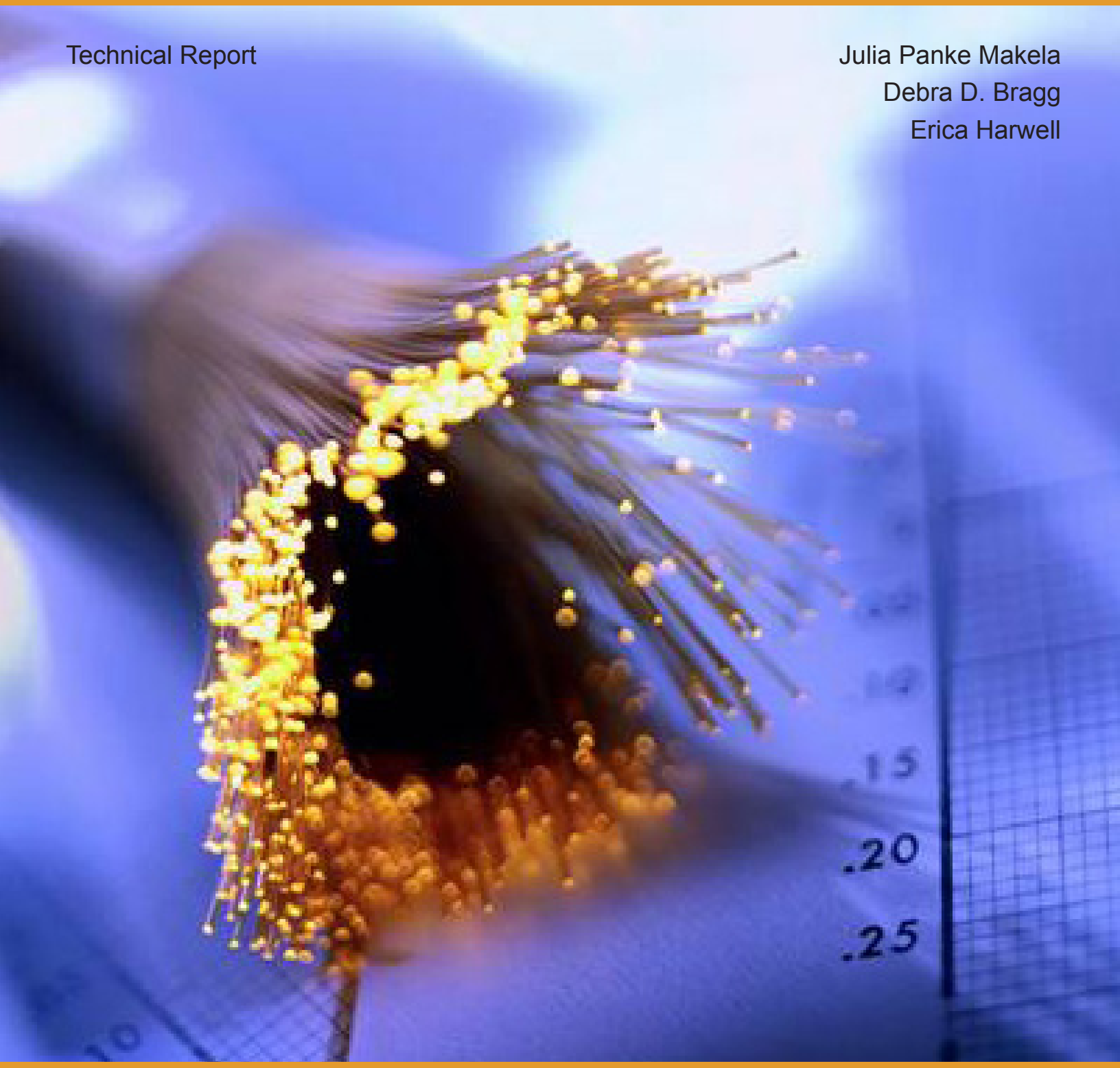

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We want to thank the colleges and universities that opened their doors to our research team to enable us to better understand the implementation and potential impact of Applied Baccalaureate (AB) degree programs. We are also grateful to our funder, the National Science Foundation (NSF), Advanced Technological Education (ATE) program. We also express our gratitude to Mark Combs, Carol Chen, and Collin Ruud who served as members of our AB research team at various points during the 5-year project. We are proud that our collective work has informed the nation's evolving conversation on AB degrees.

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Abstract

The report provides a collection of five macro-level case studies, with each case including one to four institutional case studies. In total, 11 institutional case studies are included, with the first two describing 2-year institutions that implemented the community college baccalaureate (CCB) degree and three describing partnerships that involve community colleges and universities that confer either or both associate of applied science (AAS) and applied baccalaureate (AB) degrees. The five macro cases are focused on the following regions of the country: Florida, Ohio, Oklahoma, South Dakota, and the 2-state region of Maryland and Delaware. The AB degree programs emphasize various areas of STEM and technician education, including biotechnology, biotechnology sciences, energy management, engineering technology, cybersecurity, computer and network security, networking and cyber security, information security, and information technology. Each case is analyzed from a program implementation perspective, including institutional context, program goals, key components (curriculum and instruction, support services, etc.) and intended outcomes. In addition, each case is analyzed using the *Sharing What Works* criteria to offer insights into program quality, educational significance, evidence of effectiveness, and replicability. Read together, this collection of macro-level cases provides insights into the diverse and complex ways in which AB degree programs are implemented, sustained and sometimes also scaled in five regions of the United States.

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INTRODUCTION

Policymakers are paying close attention to the community college as an economic driver, especially as pertains to science, technology, engineering, and mathematics (STEM) education. The National Science Foundation's Advanced Technological Education (NSF-ATE) program represents an important commitment of the federal government toward technician education, encouraging innovative curriculum and professional development in wide range of technical and technological education programs of study that culminate in a degree at the associate's or bachelor's level. This targeted-research on technician education was dedicated to documenting and evaluating NSF-ATE's impact on technician education in the form of new and emerging applied baccalaureate (AB) degree programs at precisely the same the time as when the federal government was shining a bright light on the community college.

Proposed in spring 2009, the Obama administration recognized the critical role that community colleges could play in driving economic development and enhancing workforce skills among new and incumbent workers, especially among the large number of citizens who had been impacted by the Great Recession. Specifically, the Obama administration's proposal to create the American Graduation Initiative (AGI) sought unprecedented federal support for community colleges update curriculum and engage faculty in professional development to promote STEM education. Of paramount importance to the AGI and all subsequent requests for support for community colleges from the Obama administration was widening access to the community college, but also emphasizing college completion. Credentialing of all forms, ranging from very short-term certificates to traditional degrees such as the associate's and baccalaureate, occurred since college completion become a high priority.

As many experts and policymakers note, the U.S. lags other nations in enrollment as well as completion of STEM fields. The National Academy of Sciences' report (2006), *Rising Above the Gathering Storm*, famously lamented the falling position of the U.S. on the world stage, highlighting the fact that women and minorities are significantly underrepresented in STEM majors and careers. This lose of talent is a serious problem for a improving and sustaining a national healthy economy. To address this problem, Malcom (2008) of the American Association for the Advancement of Science (AAAS) recommended that universities partner with community colleges to ensure that students make smooth transitions to the baccalaureate degree while simultaneously increasing enrollment by underserved students. This recommendation recognized the role of community college-university partnerships in enhancing college access and success. Community college-university partnerships that involve the articulation of applied associate coursework into baccalaureate degree, called the applied baccalaureate (AB), represent a means of potentially expanding both college access and completion in accordance with the nation's push for increased enrollment in community college STEM education, including technician education.

Why Applied Baccalaureate (AB) Degrees?

Community colleges and 4-year colleges and universities are important engines for workforce development in the U.S., making it incumbent upon these institutions to partner together, as a system, to develop pathways that offer students access to and success in college, including pathways to the baccalaureate. An educated workforce is a pivotal component of an economically competitive nation, just as postsecondary education is a primary vehicle to provide individuals with the requisite skills and knowledge to participate fully and effectively in the economy (U.S. Department of Education, 2006).

In recent decades, the AB degree has emerged as a curricular pathway that has the ability to contribute to the nation's persistent educational attainment gap. Townsend, Bragg, and Ruud (2008) defined the AB degree as a means of delivering "a bachelor's degree designed to incorporate applied associate courses and degrees once considered as 'terminal' or non-baccalaureate level while providing students with the

higher-order thinking skills and advanced technical knowledge and skills so desired in today's job market" (p. iv). Finding ways to articulate associate's degrees that were previously identified as terminal to pathways that culminate in the baccalaureate or higher is an important development in the United States.

Townsend, Bragg, and Ruud (2008) began documenting state policy and local AB program development in the 50 states in 2007, including in-depth case studies in eight states to document curriculum development and student enrollment and outcomes. According to these researchers, AB degrees have been created at the institutional and system level, occasionally rising to the level of state policy, to increase the number of baccalaureate holders in the state, often by creating new pathways from the applied associate degree to the baccalaureate degrees. These pathways have been touted, as a means of meeting employer needs as well as expanding access to both the associate as well as the baccalaureate degree in a wide range of programs of study, including STEM education. Townsend et al. (2008) documented the diverse ways that AB degree programs have been implemented throughout the United States, including documenting that AB degrees are especially important to providing access to the baccalaureate in technical majors, including in manufacturing, information technology, biotechnology, and other sectors of the workforce that employ technicians.

Due to the relative newness of AB degrees in STEM and technician education, this research included conducting case studies to provide qualitative description of AB degree programs offered by community colleges as well as universities. The purpose of these cases was to address the following research questions:

- How are AB degree programs implemented in community colleges and universities?
- What is the nature of partnerships between community colleges and universities that support AB degree programs?
- To what extent and in what ways do AB degree programs align with the *Sharing What Works* promising and exemplary programs criteria?

METHODS

This phase of the research on AB degree programs in STEM and technician education focused on case study methodologies, supplemented with participatory research. The research design was similar to one used in previous research led by Bragg and colleagues affiliated with a federally funded project called *Sharing What Works: Exemplary and Promising Career and Technical Education Programs* (see Bragg, Bobik, Maxwell, & Palovik, 2002). This multi-year project, funded by the U.S. Department of Education, Office of Vocational and Adult Education, entailed the development of criteria and an evidence-based process for identifying and recognizing exemplary and promising programs, including technical education programs offered by community colleges. This project involved an extensive literature review and practitioner-expert input on what constitutes quality career-technical education (CTE) to identify four categories of criteria for promising and exemplary CTE programs of study:

- **Program quality** – demonstrates clear goals, evidence-based, reflective of high expectations, and supportive of career pathways.
- **Educational significance** – uses state-of-the-art technology, innovative instructional methods, work-based learning, and culturally inclusive curriculum.
- **Evidence of effectiveness** – demonstrates student academic achievement and outcomes consistent with industry, state, and national standards.
- **Replicability** – uses program and partnership designs that are feasible for other institutions, partnerships and employers to implement.

In the original *Sharing What Works* project and in this study, practitioner-experts with deep knowledge of technical education were utilized to help identify AB degree programs that would be optimal sites for participatory field research. Thus, technical experts drawn from NSF-ATE projects and centers and from the advisory committee named at the outset of this grant were engaged in conducting the research, including meeting requirements to be certified under the University of Illinois Institutional Review Board (IRB) and conducting interviews and observations along side university researchers while visiting selected sites. This mix of researcher and practitioner-expert often led to active dialogue among site personnel and researchers that was useful to understanding the current status and future potential of AB degrees.

Using this methodological approach, this study involved in-depth qualitative case studies in selected AB degree programs located in multiple states. These AB programs were identified using survey research conducted wherein personnel associated with NSF ATE centers and projects self-identified AB degree programming, including AB degree programs administered by community colleges solely as well as college-university partnerships. Using qualitative research methods, including case study, personal interviews, focus groups, and observations, we gathered data on program implementation, quality of programming (utilizing the *Sharing What Works* criteria), and perceptions or actual outcomes, depending on the availability of quantitative data on student outcomes. Teams of two to four individuals, including one practitioner-expert visited the selected community colleges, universities, employers and other partners to learn how AB programs operated and how students/graduates experienced them and perceived of their impact on their future education and employment outcomes. The perspective of employers and professional organizations were gathered as well. As noted, the data sources included interviews, focus groups, documents, websites, and student- and institutional-level data. We used semi-structured interview protocols, where the interview questions were designed to start a conversation, with follow-up questions used to probe relevant answers. A similar approach was used with student focus groups. This approach was chosen because the relative newness of the AB degree made it important for participants to tell their story about the most valuable features of the programs and their perceptions of how they were working and the impact they would have. To the extent possible, student enrollment and outcomes were documented; however, our research revealed very limited evaluation of AB degree program student outcomes.

ORGANIZATION OF THIS REPORT

The remainder of this report is organized into five macro cases, with each case including one to four institutional case studies that represent the inter-relationships between institutions that are necessary for AB degree programs to exist in the AB degree format that involves transfer between two- and four-year institutions. In total, 11 institutional cases are included in the five macro cases, with the first two describing the distinctive nature of AB degree programs offered in the form of community college baccalaureates (CCBs) by institutions that are predominantly associate's degree conferring institutions. The following three cases describe that involve community colleges and universities that confer associate and applied baccalaureate (AB) degrees. The five macro-level cases follow:

- Bismarck State College that confers a Bachelors of Applied Science (BAS) in Energy Management.
- Daytona State College and confers a Bachelors of Science (BS) in Engineering Technology.
- CyberWatch (NSF-ATE) Center and its partners that confer the Associate of Applied Science (AAS) in Information Security at Prince George's Community College, Bachelor of Science (BS) in Cybersecurity at the University of Maryland-University College's, and the Bachelor of Science (BS) in Computer and Network Security at Wilmington University.
- Lakeland Community College and is partners that confer the Associate of Applied Science (AAS) in Biotechnology Sciences that transfers to Ursuline College's Bachelors of Arts (BA) in Biotechnology.

- Oklahoma State University Institute of Technology and its partners that confer multiple degrees as follows: Oklahoma State University Institute of Technology's Bachelor's of Technology (BT) in Information Technology, Associate of Science (AS) and Associate of Applied Science (AAS) in Information Technology, Rose State College's Associate of Applied Science (AAS) in Networking and Cyber Security, and Tulsa Community College's Associate of Applied Science (AAS) in Information Technology.

Each case is analyzed from a program implementation perspective, including institutional context, program goals, and intended outcomes. In addition, each case is analyzed using the *Sharing What Works* criteria that focus on program quality, educational significance, evidence of effectiveness, and replicability. Together, these macro-level cases provide insights into the diverse and complex ways in which AB degree programs are being implemented, sustained and in some cases scaled in the five regions of the United States.

BISMARCK STATE COLLEGE'S: BACHELORS OF APPLIED SCIENCE IN ENERGY MANAGEMENT

Bismarck State College is a public, primarily associate degree-granting institution located in Bismarck, North Dakota. The college was established in 1939 as Bismarck Junior College (BJC) in order to address the need for advanced education in Bismarck and the surrounding area. Initially BJC was governed by the local public school district and occupied the top floor of a local high school. A total of seven faculty members and 50 students made up the BJC community in that first academic year. As enrollments grew and program offerings expanded, new spaces were needed to house the growing college. In 1959, Harold Schafer, a local business leader and philanthropist, donated acreage for a permanent site for the college along the Missouri river. Today, the campus consists of 18 buildings on this site, as well as three other local sites that provide instruction for several technical programs.

In 1987, BJC and the other two-year colleges in North Dakota became part of the North Dakota University System, moving them out from their original governance relationships with the public K-12 school districts. This new governance relationship "resulted in greater credibility for the College and offered a number of significant advantages, such as opportunities for collaboration, improved student transferability, and membership in a unified educational body" (http://www.bismarckstate.edu/uploads%5Cresources%5C906%5Caqipoverview.pdf, p. 1). These new relationships were also the impetus for changing the institution name from BJC to Bismarck State College.

Bismarck State College (BSC) is accredited regionally by the Higher Learning Commission (HLC) of the North Central Association of College and Schools. The institution offers programs for students who intend to transfer to a bachelor's degree (Associate in Arts degree or Associate in Science degree), as well as technical programs (nearly 40 programs leading to a certificate, diploma, or Associate in Applied Science degree). There are 16 programs offered online which lead to a certificate of completion, program certificate, or associate degree, as well as numerous general education courses offered online. Nearly 20 bachelor's degree and several graduate degree programs are offered on campus in cooperation with other North Dakota University System institutions. A single bachelor's degree is offered and awarded by Bismarck State College – the Bachelor's of Applied Science (BAS) in Energy Management. This BAS in Energy Management is offered fully online and is designed for those seeking supervisory and management positions in the energy industry (http://www.bismarckstate.edu/about/, Retrieved March 22, 2013).

Bismarck State Colleges portrays their institution as "an innovative community college." Their mission is to offer "high quality education, workforce training, and enrichment programs reaching local and global communities" (http://www.bismarckstate.edu/uploads%5Cresources%5C906%5Caqipoverview.pdf, p. 2).

Current BSC Students

Bismarck State College (BSC) reports that, in Fall 2010, 4,177 students were enrolled in their for-credit programs, with 13,660 served annually through their continuing education programs (http://www.bismarckstate.edu/about/, Retrieved March 22, 2013).

According to the National Center for Education Statistic (NCES) Integrated Postsecondary Education Data System (IPEDS) College Navigator, in Fall 2011, a total of 4,392 students were enrolled in undergraduate degree programs at Bismarck State College (291 of those as transfer-in undergraduate students). Of those students, 60% attend full-time and 40% attend part-time. Approximately 54% of undergraduate students are male, and 46% are female. A total of 88% of the undergraduate student body self-identified as White / Caucasian, 2% as Black or African American, 2% as Hispanic/Latino, 1% as American Indian or Alaska Native, and 2% as two or more races. "Race ethnicity unknown" was reported for 3% of undergraduate students. Asian was reported for 0% of undergraduate students. The majority of students (94%) are in-state

residents, with only 6% out-of-state residents. In regards to students' age, 65% were reported as 24 and under, and 35% were reported as 25 and older.

Across BSC the student-to-faculty ratio is 12:1. The IPEDS data from Fall 2011 reports 124 employed full-time faculty and 237 part-time faculty, all primarily serving in instructional roles.

In the 2012-2013 academic year, tuition and fees for in-state students in on-campus certificate and associate degree programs was approximately $140 per credit hour (approximately $166 with fees). Out-of-state students in on-campus certificate or associate degree programs pay a higher rate of approximately $299 per credit hour (approximately $325 with fees). For online programs, there is no difference in tuition prices for in-state versus out-of-state students. Tuition was set at $216 per credit hour (approximately $242 with fees) for most technical certificate and associate degree programs ($176 per credit hour was the cost for the majority of online offerings (e.g., general education, electives) for the college. Tuition was set at $227 per credit hour (approximately $253 with fees) for the BAS in Energy Management degree program. (See http://www.bismarckstate.edu/current/finance/sf-tuition-fees/tuition-2012-13/, Retrieved September 13, 2013.)

The BAS Degree in Energy Management

The National Energy Center of Excellence (NECE) housed in a 106,200 square foot building that houses classrooms, an auditorium, training labs, simulator labs, computer labs, a student study lounge, media studio, college administrative offices, and so on. Although the building itself is not LEED (Leadership in Energy and Environmental Design) certified, it meets the requirements for energy efficient lighting systems; is heated, cooled and ventilated from a geothermal system; and is constructed with the use of Flexcrete – a construction material that is recycled from coal combustion byproducts (http://energy.bismarckstate.edu/nece/building-highlights/, Retrieved March 27, 2013). The building was opened in July 2008. Funding for the building was contributed by industry partners, state and federal agencies, BSC employees, community members, and individual donors, with $23 million contributed, not counting the equipment in the state-of-the-art laboratory facilities (EHN1, p. 5). The BSC Foundation played the lead role in helping to secure the funding to support the building project. In addition, long-time employer partners contributed significant amounts to the project, with one local employer making a lump sum contribution of $2 million. Internal support for the project was also described as "tremendous," with BSC employees also donating "over $200,000 to the building project" (EHN1, p. 6).

The NECE offers 12 nationally-recognized energy industry degree and training programs. Table 1 provides an overview of programs offered and the approximate years that they were added to the NECE portfolio. Currently, student enrollments in these degree programs make up approximately one-fourth of the total student body of the BSC campus. Program administrators reported that: "Ten years ago, there were very few colleges that were teaching in this kind of area. If they did, they only had one or two programs. But now, you're starting to see more and more of them" (EHN1, p. 6). As community colleges across the country look to start energy programs, they often come to BSC looking for ideas and guidance. BSC has created partnerships to assist community colleges in Kentucky, Connecticut, and other states.

Table 1. National Energy Center of Excellence Programs

Year Created	Program	Abbreviation
1970	Lineworker	LNWK
1976	Power Plant Technology	PWRP
1981	Process Plant Technology	PROP
2001	Electric Power Technology	ELPW
2003	Electrical Transmission Systems Technology Nuclear Power Technology	ETST NUPT
2007	Mechanical Maintenance	MMAT
2008	Energy Management (BAS) Instrumentation and Control	ENRG ICTL
2010	Renewable Generation Technology	RENG
2011	Petroleum Production Technology	PROD
2012	Water and Wastewater Technology	WATR

The "Center of Excellence" title stemmed from a program started by North Dakota Governor Hoeven (Governor from 2000 – 2010, http://www.history.nd.gov/exhibits/governors/governors31.html, Retrieved September 12, 2013). Governor Hoeven began the "Center of Excellence" program in the state to encourage higher education institutions to develop "expertise in one or two areas around their area of strength" (EHN1, p. 17). Institutions could apply to become a "Center of Excellence" in an area and, if the designation was awarded, the institution would be awarded up to $3 million from the state to further strengthen programming in that area. In May 2007, the NECE was designated as the National Power Plant Operations Technology and Energy Center by the U.S. Department of Energy. Program administrators reported that BSC holds the only such title ever awarded, and it is "a big award for us" (EHN1, p. 6) in terms of the support that it offered for recognition and reputation building. Putting these two designations together, the energy programs at BSC became affiliated under the "National Energy Center of Excellence" (EHN1, p. 17).

In 2007, a new President was brought into the leadership position at BSC. Examining the program offerings at the institution, the new President determined that BSC's unique niche was energy. He wanted to provide the energy program administrators and faculty with "a more responsive environment, flexibility and control to keep growing in the energy area meeting industry's needs" (EHN1, p. 2). In order to achieve this goal, he restructured the organization of the institution to separate the energy-related curriculum from other academic departments (which report to the academic Provost) and created a Vice-President of NECE in 2007 who reports directly to the President (See Figure 1). The Vice-President of NECE oversees all academic programs related to energy, including 11 associate degree programs, numerous certificate programs, and the BAS in Energy Management – the sole bachelor's degree offered at Bismarck State College. Despite the organizational separation that offers some flexibility, the Vice President of NECE works closely (EHN1, p. 26) with the Provost and Vice President of Academic Affairs who oversees all other academic programs.

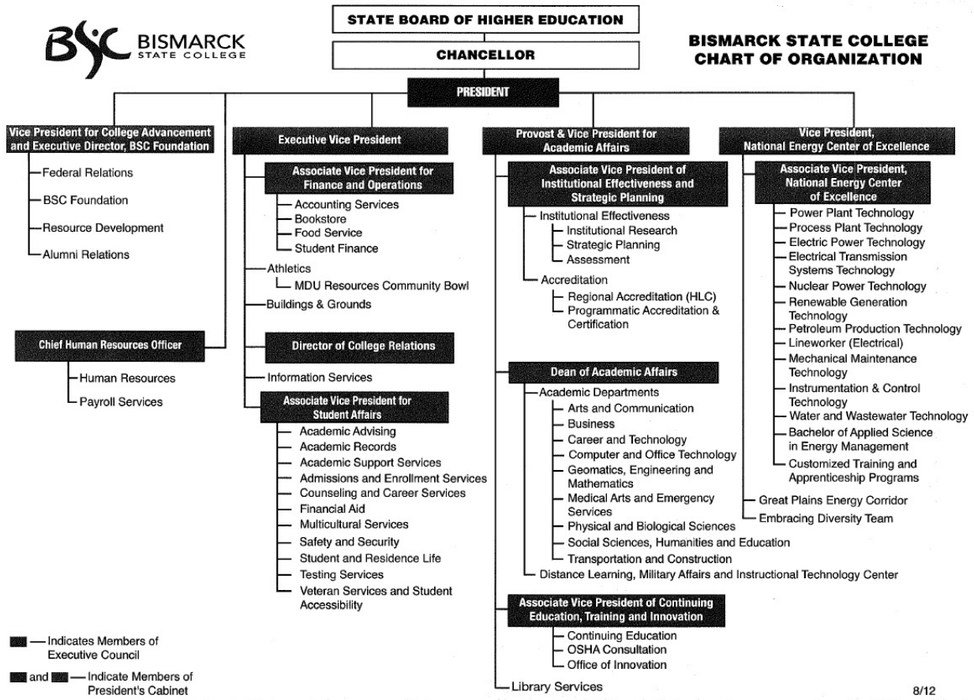

Figure 1. Bismarck State College Organizational Chart

Planning for the BAS degree in Energy Management began in 2005. The idea for the BAS degree program was spurred by local industry partners who were looking for mid-level managers with technical backgrounds. They began communicating, both verbally and in written letters, that "we need to have this… A lot of engineers become managers. They are a great engineers, but all of a sudden now they're supervising and managing employees … they also need management skills" (EHN1, p. 15). As described by one Industry Advisor who was a part of the original team who designed the BAS degree:

> What we have around here is we have a number of energy facilities, and we have people get their two-year degrees, or maybe they've never had a degree at all. The older workers, a lot of them don't. But they got to the point where they were kind of dead-ended in terms of – They had great technical knowledge, great practical experience, but to take that next step to get into management and supervision, they needed a little bit bigger background on some things. And so, the four-year program was really initially created to help out in that area. (Employers, p. 3)

BSC heard initial calls for an Energy Management program, and decided to research the idea with an industry survey to their employer partners, graduates, and current students. The results of the survey demonstrated "overwhelmingly that industry said we needed this" (EHN1, p. 16) and the desired skill areas expressed in the survey became the foundation for the ten core energy management courses that make the up the program today.

Establishing the Energy Management degree program as a four-year BAS degree to be offered at and conferred by BSC, historically an associate degree-granting institution, was a difficult task. BSC encountered "huge opposition at the state higher education level" (Employers, p. 17), led by other four-year institutions in the state who did not want to see BSC venture into the territory of offering bachelor's degrees. The situation was described to our research team by an Industry Advisor who was "in the middle of that battle" (Employers, p. 17). He shared that:

> It was like we can't let that happen because this is a two-year school, and once that camel gets its nose under the tent, you know, I mean, Bismarck is the second largest city in the state, and we don't have a four-year public school here. So the competing schools, mainly Dickinson and Minot, and the universities didn't want it to happen. (Employers, p. 11)

In response, BSC crafted a "very practical" message three key arguments: (1) special regional industry need, (2) targeted student population, and (3) BSC as the ideal education provider. The Industry Advisor who played a role in these early negotiations described the experience as follows:

> The argument we had to use, which was very practical in nature, is we have a special need in this area for an energy management four-year degree. We have a lot of people who are out there, who are out there working in industry right now, who cannot quit their job and go off to a university or go off to a school and get a four-year degree. They're working. They have families. But we need to give them the skills. And because BSC was ideally situated for what they do, geographically they're located where they need to be… This is mainly intended for people who are out there working, who want to take the next step and become a supervisor or manager. And we need to provide them with the skill sets to do this, and this school is in the right place. A lot of these people have gone through programs here, and we want to provide them that.
>
> So it was a tough argument, and I had to testify in front of the legislature. I said, "This is what industry needs. This is why this is the best place to do it. Nobody else offers the comparable things of what Bismarck State College can for these people who are out there, who need this." (Employers, p. 17)

The "real fear" behind much of resistance to BSC offering the BAS in Energy Management was that one bachelor's degree may lead to others, and that BSC would "become a 4-year school that would compete for resources" with the other four-year institutions in the state. However, the arguments that were being used against the BAS in Energy Management degree were more veiled, saying "We teach very similar things" (Employers, p. 19). Industry Advisors refuted those claims, responding:

> I've looked at what the 4-year programs out there were, and there were a lot of things that you're going to find in the curriculum [at Bismarck State College] that they don't have an equivalent. … I mean, project management, for example, anybody that works in any of our facilities, if you're going to get anywhere up the ladder, you've got to know how to manage projects. You've got to know how to manage budgets. You've got to know how to manage schedules. And they don't teach that. (Employers, p. 19)

Industry representatives backed up their claims with substantial monetary and material support for starting the BAS in Energy Management degree program at BSC. The Industry Advisor who played a role in the early negotiations shared that "I think we kind of surprised [the legislators] really" (Employers, p. 20). Decisions began to turn in BSC's favor, although "there were always strings attached – 'well, yes, if you can get 50% in contributing funds from industry, we'll go along with it'" (Employers, p. 20).

BSC was granted permission by the North Dakota State Board of Higher Education to offer a Bachelor's of Applied Science (BAS) degree program in Energy Management in November 2006. The program was formally established in 2008. The program was initially offered through the Business and Management

department on campus, and later moved to the NECE due to its focus on the energy industry. BSC was able to secure sufficient industry contributions, as well as to receive grants to support development of the NECE building and to secure additional equipment.

Since establishing the BAS degree in Energy Management, BSC has not sought to add any additional bachelor's degrees to the degrees that it confers (although courses for other bachelor's degrees are offered on BSC's campus through partnerships with other four-year institutions, in which the partnering institutions confer the degree). As described by the Industry Advisor who played a role in the early negotiations for establishing the BAS degree, BSC has stayed true to the "core reason of why the four-year program was created" (Employers, p. 17). He says of the degree program:

> You [Bismarck State College] know you don't want to be a four-year school. What you want to be is you're trying to take a work group or some kind of specialized area that you are either very good at or you can service a need that the universities can't. (Employers, p. 17)

Curriculum Design. The BAS in Energy Management at BSC is the only program of its kind currently available in the U.S. The degree program was designed to educate individuals who are interested in moving into supervisory and management positions within the energy industry. The BAS degree program builds on energy-related foundations developed in previously completed energy education programs, and includes General Education classes, Management courses, and Energy Management courses. This program was designed to be offered entirely online, allowing students to access classes around their work schedules.

Individuals may be eligible for the program if they meet one of three requirements:

a) Earned an energy-related AAS, diploma or certificate;
b) Earned an associate degree (not energy-related) and works in the energy industry; or
c) Has completed 48 technical and/or elective credits and either works in the energy industry or is currently in the military.

For application to the BAS degree program, COMPASS placement exams are required in both English and math. For students who do not have access to COMPASS testing facilities, completion of the ACCUPLACER assessment may be substituted. Official transcripts must also be submitted from all colleges and universities previously attended.

The curriculum builds on the foundations that students have gained in previously-completed energy education programs, such as the Associate in Applied Science (AAS) degrees offered in affiliation with the NECE located at BSC (see Table 2). To enroll in the degree program, a student must have completed an AAS degree, certificate, or diploma in an approved energy-related program of study from a regionally accredited institution. Previous college coursework along with industry or military training or experience may also be considered in lieu of a credential (http://energy.bismarckstate.edu/programs/enrg/whatenrg/, Retrieved March 22, 2013).

Table 2. Certificate and Associate Degree Programs Affiliated with the National Energy Center of Excellence

Field	Certificate and Associate Degree Options	Location
Electric Power Technology	Associate in Applied Science (AAS) Program Certificate	Online
Electrical Transmission Systems Technology	Associate in Applied Science (AAS) Program Certificate Continuing Education Hour-only (CEH-only) courses	Online
Instrumentation & Control	Certificate of Completion in Electronics (ELEC) Certificate in I&C Associate in Applied Science (AAS)	On-campus or Online
Lineworker	Associate in Applied Science (AAS) Program Certificate	On-campus
Mechanical Maintenance Technology	Associate in Applied Science (AAS)	On-campus
Nuclear Power Technology	Associate in Applied Science (AAS) Program Certificate	Online
Petroleum Production Technology	Associate in Applied Science (AAS) Program Certificate	Online*
Power Plant Technology	Associate in Applied Science (AAS) Program Certificate	On-campus or Online*
Process Plant Technology	Associate in Applied Science (AAS) Program Certificate	On-campus or Online*
Renewable Generation Technology	Associate in Applied Science (AAS) Program Certificate	On-campus or Online*
Water & Wastewater Technology	Program Certificate	Online*

* Some online courses require brief on-campus labs or shadowing at an approved facility.

Previous college coursework is transferred into the degree program, and additional coursework is required to meet the 120-credit minimum for the bachelor's degree (BAS Brochure, 2012). Altogether, students must complete 48 hours of technical/elective semester credits (often drawn from associate degree or certificate transfer credits), 42 hours of general education semester credits, and 30 credits of energy management semester credits (http://energy.bismarckstate.edu/programs/enrg/grad/bas/, Retrieved March 22, 2013). The energy management portion of the curriculum includes 10 required 3-credit-hour courses (see courses titles listed in Table 3). Students study accounting, project management, organizational behavior, human resource management, communications, workforce safety, ethics, government regulations, energy markets and economics, facility management, and emerging energy technologies. At least 30 credit hours must be completed at BSC, at least 30 semester hours of credit must be upper division (300/400) level courses, and a minimum of a 2.0 institutional GPA (BSC GPA only) and a minimum of a 2.25 cumulative GPA (BSC and transfer GPA) are required for graduation (http://energy.bismarckstate.edu/programs/enrg/grad/bas/,

Retrieved March 22, 2013). Students must submit an application for degree at the beginning of the term in which they expect to graduate.

Table 3. Required Energy Management Courses in the BAS Degree Program

Course Number	Course Title
ENGR 302	Ethical Issues in the Energy Industry
ENGR 310	Energy Production and the Environment
ENGR 315	Energy Management Communications
ENGR 320	Workforce Safety
ENGR 330	Government Regulations in the Energy Industry
ENGR 404	New and Emerging Energy Technologies
ENGR 412	Energy Economics and Finance
ENGR 420	Energy Markets and Structures
ENGR 430	Project Management in the Energy Industry
ENGR 435	Managing Energy Facilities

The BAS in Energy Management is offered entirely online, and new courses begin on an eight-week cycle (with two 8-week cycles per standard academic term). The majority of courses are offered three times a year, and there are no pre-requisites for any course. This allows students the flexibility to begin the program at almost any time, and to pick up courses in any order. Students are expected to spend approximately 10-15 hours per week working within a single online course plus additional time outside of the course (research, writing papers, studying, etc) (http://energy.bismarckstate.edu/programs/enrg/cs/, Retrieved March 22, 2013).

Math requirements. Among a list of "Business, Math, Science, and Technology" courses, a single math requirement of 3-credit hours is listed for the BAS degree. The required course is Applied Algebra (or higher). Students are also required to take two accounting courses: Elements of Accounting I and Elements of Accounting II. Students may elect to replace the second accounting course with College Algebra, or higher-level math course. Also of note, students are required to complete a single, 3-credit hour, non-lab science course.

Academic Tracks. When the BAS in Energy Management was initially created, an alternative was made available to students who did not wish to seek the full degree – an Energy Management Certificate of Achievement. This certificate could be earned by completing the 10 Energy Management courses, equaling 30 semester hours (BAS in Energy Management brochure, 2011, p. 1, http://www.bismarckstate.edu/uploads/resources/155/energy-management.pdf). Note that, in this academic track, while students were completing the same core courses as BAS degree students, the 42 hours of general education semester credits and 48 hours of technical/elective semester credits were not required for the credential to be received. During our site visit in April 2013, we were informed that this Energy Management Certificate program was no longer being offered. One program administrator shared that: "We don't have the Certificate of Completion anymore, the interest just wasn't there from the student perspective" (BSC7, p. 1).

Program-level Student Learning Outcomes. Seven program-level student learning outcomes have been set for the BAS degree program, including:

1. Exhibit management skills in the areas of communication, ethics, human resources and project management.
2. Demonstrate comprehension of the government regulations and compliance issues that impact the energy industry.
3. Demonstrate an understanding of safety and environmental issues, laws, rules, history and policies relating to the energy industry.
4. Demonstrate an understanding of new and emerging technologies as they relate to the energy industry.
5. Demonstrate an understanding of the functional areas of accounting, marketing, finance, and economics that apply to an energy industry manager.
6. Demonstrate an understanding of the ethical obligations and responsibilities of the energy industry manager.
7. Synthesize the elements of energy management through the completion of the capstone project.

Table 4 provides a mapping of these seven student learning outcomes to the required general education and core energy management courses within the BAS in Energy Management degree program.

Transfer and Articulation Agreements.

Air University Associate to Baccalaureate Cooperative Program. Since October 2009, BSC has been approved by the Air University Associate to Baccalaureate Cooperative Program (AU-ABC) to provide the BAS in energy management online program for Community College of the Air Force (CCAF) graduates. Originally, the approval was for the transfer of six AAS degrees; since 2009, the transfer relationship has grown to receive more than 2-dozen AAS degree programs (See Table 5 and http://www.bscmilitaryonline.com/airforce/auabc/, retrieved March 26, 2013). A total of 60 credits from the CCAF degree programs transfer – 48 technical and program electives, 3 credits of math, and 9 credits of general education (speech communication, English, and an arts/humanities elective). Students are then required to take an additional 60 credits at BSC – 30 credits of energy management core courses, 18 credits of business/math/science/technology courses, 6 credits of economics courses, and 6 credits of additional general education (English and an arts/humanities elective). This adds up to a total of 120 credit hours for the full BAS degree. Students who are interested in transferring are encouraged to visit the BAS degree website or to contact the BAS degree coordinator at BSC for information.

Table 4. Mapping of Student Learning Outcomes to Required General Education and Core Energy Management Courses in the BAS Degree Program*

Course No.	Course Title	Student Learning Outcomes						
		1	2	3	4	5	6	7
General Education Courses								
ECON 201	Microeconomics					x		
ECON 202	Macroeconomics					x		
ACCT 200	Elements of Accounting I					x		
ACCT 201	Elements of Accounting II or MATH 103 College Algebra (or higher)					x		
BADM 202	Principles of Management	x						
BADM 281	Organizational Behavior	x						
BADM 282	Human Resource Management	x						
Core Energy Management Courses								
ENGR 302	Ethical Issues in the Energy Industry	x					x	
ENGR 310	Energy Production and the Environment		x	x				
ENGR 315	Energy Management Communications	x						
ENGR 320	Workforce Safety		x	x				
ENGR 330	Government Regulations in the Energy Industry		x	x				
ENGR 404	New and Emerging Energy Technologies				x			
ENGR 412	Energy Economics and Finance					x		
ENGR 420	Energy Markets and Structures		x			x		
ENGR 430	Project Management in the Energy Industry	x						
ENGR 435	Managing Energy Facilities	x	x	x	x	x	x	x

*Reproduced from a Student Learning Outcomes handout received from BAS degree program administrators (April 2013).

Table 5. Community College of the Air Force Associate in Applied Science Degree Programs that Articulate with the Bismarck State University's Bachelor's in Applied Science in Energy Management

Aviation Maintenance Technology	Information Systems Technology
Bioenvironmental Engineering Technology	Instructor of Technology & Military Science
Computer Science Technology	Logistics
Construction Technology	Maintenance Production Management
Contracts Management	Mechanical & Electrical Technology
Electronic Systems Technology	Metals Technology
Emergency Management	Missile & Space Systems Maintenance
Environmental Systems Technology	Munitions Systems Technology
Explosive Ordnance Disposal	Nondestructive Testing Technology
Financial Management	Safety
Fire Science	Transportation
Human Resource Management	Vehicle Maintenance
Information Management	Weather Technology

Salt Lake Community College. An articulation agreement also exists between Salt Lake Community College's (SLCC) Associate of Applied Science in Energy Management degree program and BSC's BAS degree program in Energy Management, effective since February 2011. The AAS degree in Energy Management at SLCC prepares students for technical professions examining energy-related sub-systems including heating, ventilation and air conditioning systems, electrical and lighting systems; building envelope; energy analysis techniques; building simulation methods; life cycle costs and return on investment calculations; and alternative energy sources. Students apply these skills to recommend improvements that result in greater energy efficiency and energy cost savings in residential and commercial buildings (AAS in Energy Management Brochure, 2013, http://centralpt.com/upload/539/energymanagement/16812_2013.02.11_EnergyMgt_brochure_web.pdf). The degree program is offered in an accelerated (18-month) model, where students complete courses in seven, 10-week blocks. New students begin the program each fall as a cohort of up to 25 students. The first cohort of students began the program in Fall 2009. Students are expected to "be committed to adhere to the program's schedule and to complete it with their assigned cohort."

Students who transfer to BSC's BAS in Energy Management degree program from SLCC complete the program by following three steps. They begin by successfully completing their AAS degree program at SLCC, which requires 16 credits of general education, 45 credits of core program requirements, and 5 credits of electives – a total of 66 credits. From this degree program, many of the AAS degree credits transfer to the BAS degree, leaving a set of 31 credit hours of "transfer recommendations" that students may complete at SLCC to meet the majority of BSC's remaining general education requirements. These include 6 credits of economics, 6 credits of accounting, 4 credits of college algebra (the highest math required), 6 credits of management courses, 3 credits of intermediate writing, and 6 credits of fine arts/humanities electives. Many students do chose to complete general education courses such as microeconomics and macroeconomics at their local community college because it is less expensive to take these courses through their local campus than to pay the online rate through BSC (EHN2, p. 6). The final step is for students to complete 30 hours of online energy management courses through BSC.

Graduation requirements mirror those for native BSC students. A minimum of 30 credit hours must be upper division. A minimum of a 2.0 GPA (at BSC only) and a minimum of a 2.25 cumulative GPA (BSC and transfer GPA) is required for graduation (BSC – SLCC Transfer Worksheet, 2011).

Other Articulation Agreements. An articulation agreement, effective since September 2009, exists between BSC's BAS in Energy Management and several AAS degrees at Bellingham Technical College in Bellingham, WA, including: Process Technology, Electro Mechanical Technology, Instrumentation & Control Technology, and Electrician. An agreement exists between BSC's BAS in Energy Management and the AAS degree in Environmental Technologies and Sustainable Practices – Technology Emphasis at Cascadia Community College in Bothell, WA. This agreement has been effective since December 2009.

BAS Student Enrollment and Demographics

According to BSC Student Profiles, during the 2012-2013 academic year, 244 students were enrolled in the BAS in Energy Management degree program. At the end of the Fall 2012 semester, a total of 163 students were enrolled in the 10 required core Energy Management courses for the BAS degree. (The remaining 81 students were enrolled in general education or elective courses during the Fall 2012 semester.) Of the 163 students enrolled in the core Energy Management courses, 12 (7%) were female and 151 (93%) were male. In comparison to gender, much greater variation is seen in age and geographic diversity. As can be seen in Figure 2, students enrolled in Energy Management courses come from a variety of ages, including a small number of traditional college students (6%; ages 18 – 25), as well as a quarter of students in the courses being older than 45 years of age.

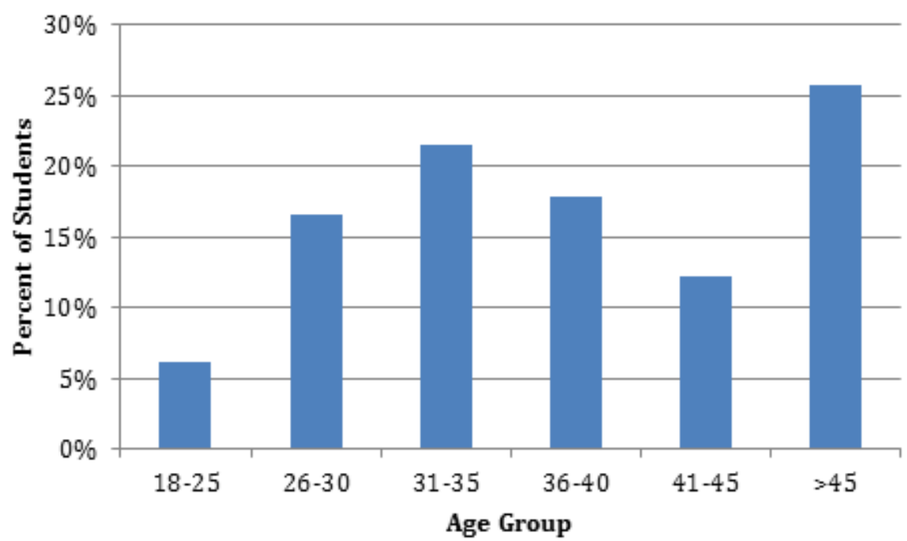

Figure 2. Percent of students enrolled in energy management courses at the end of the Fall 2012 semester by age group.

Geographically, students enrolled in Energy Management courses at the end of the Fall 2012 semester came from 41 states, the armed forces, and Canada. Locations with the largest representation included: North Dakota (12%), Minnesota (9%), Washington (7%), Texas (6%), and Colorado (5%). All other locations had fewer than 5% of student enrollments, which amounts to 7 or fewer students. Program administrators estimated that 55% of students in Spring 2013 completed their associate degrees at BSC.

Program administrators reported that, in recent years, they have had approximately 30-40 students graduate each year (Survey responses, p. 2). The majority of BAS students are "former students of BSC who received an AAS degree and have now returned for the Energy Management program" (Survey responses, p. 1). Students in the BAS program are typically "already employed in the energy industry and are utilizing the program to enhance their knowledge and current career, not to become employed in the industry" (Survey responses, p. 2). The program attracts technicians and operators who are looking to move into supervisory and management roles. As such, the program caters to non-traditional, older adult college students who bring work experience, as well as associate degree education, to the classroom.

Approximately one-fifth (33, or 20%) of the 163 students who were enrolled in Energy Management courses at the end of Fall 2012, are listed as being employed by "non-industry" employers. The remaining 132 students were employed by 85 different companies. Employers with the largest numbers of students enrolled in the Fall 2012 term include: Xcel Energy (7 students, 4% of total 163), US Air Force (6 students, 4% of total), and Siemens Energy Inc. (5 students, 3% of total). The majority of employers (62, 73% of total 85) had a single employee enrolled in Energy Management courses at the end of Fall 2012. GetEducated.com, a consumer group that publishes online college and university rankings, rated the BAS in Energy Management the seventh most affordable online management degree in the nation. Based on costs from spring 2011, BSC's Energy Management degree received an A- in the rating scale and its overall degree cost of $29,194.

Faculty Roles and Positions

The BAS in Energy Management degree program has one full-time faculty member and approximately 6 to 10 adjunct faculty members. The full time faculty member teaches 4 of the 10 core classes per semester. The remaining classes are taught by adjunct faculty members, at times with multiple sections running at a time. The adjunct faculty members are "industry-experienced instructors" (http://energy.bismarckstate.edu/programs/enrg/, Retrieved March 22, 2013), each with 15 plus years of experience, who are located in organizations across the country. The program administrators reported that they are "actually trying to build our adjunct group" (EHN2, p. 12) so that they can offer more course sections. However, recruiting qualified and talented adjuncts has been one of their "biggest challenges" to date.

Full-time faculty members serve in a "mentor/monitor" role to assist adjunct faculty and to "make sure they're doing a good job" (EHN1, p. 14). The full-time faculty member provides each adjunct faculty member with a personalized feedback form, and student survey data is collected and analyzed for each class as well.

Challenges and Areas of Concern

Whereas in other cases for this AB project our research team has heard about challenges emerging from cultural shifts required when associate and bachelor's degrees are offered on a single campus, BSC administrators, faculty, and staff did not experience such difficulties on their campus. Informants that we spoke with hypothesized that the comfort with multiple degree types may stem from long-standing partnerships and blurred lines within the environment. One program administrator shared that BSC has "a

lot of bachelor's programs offered here on campus" (EHN2, p. 10) in which the degrees are conferred by the partnering baccalaureate-degree granting institution. Within these relationships, "a lot of [Bismarck State College's] traditional faculty, they teach as adjuncts for the [partnering] colleges. So they'll teach at night for Dickinson State or Minot State or UND [University of North Dakota], [while they are] a full-time BSC employee" (EHN2, p. 10). These existing relationships have created an environment in which "most of the faculty are pretty open to bringing in more programs," (EHN2, p. 10) even those at the bachelor's degree level.

If there is any sense of tension on the BSC campus, program administrators and faculty in the NECE recognize that "faculty are very high cost" (EHN2, p. 9) in their degree program because "if we're going to play in this area, we're going to have to be somewhat competitive with industry. We're not there, but we're somewhat competitive" (EHN2, p. 10). The discrepancy in budgets for faculty salary can cause some difficulty. Yet, this is disparity is not limited to the difference between bachelor's and associated degree levels. A disparity is also apparent between technical and non-technical fields.

Sharing What Works: Program Quality

Industry standards were often discussed by program administrators and faculty during our site visit, yet these standards were discussed in relation to the AAS degree programs, rather than the BAS degree program in Energy Management. The Nuclear Power Technology program was given as an example, and was described as being "way ahead of the rest of the industry, just because they have to be" (EHN1, p. 9). Degree programs in Nuclear Power are required to follow the Nuclear Uniform Curriculum Program which outlines a specific set of objectives that must be met. Each college must have "an industry partner that verifies to the NEI [Nuclear Energy Institute] that the curriculum meets the standards" (ENH1, p. 9). Students who graduate from an NEI-approved program receive a certificate upon graduation, signed both by NEI and the industry partner, showing that they met the industry education requirements.

Employer Partnerships. One program administrator shared that "the strength of Bismarck State Colleges' National Energy Center of Excellence has been our long standing tie and partnership with industry" (Survey responses, p. 3). He went on to share that their first energy program began in 1970, they have since evolved their portfolio into 11 Program Certificate and AAS-degree programs and the BAS degree in Energy Management, as well as "a variety of non-credit offerings geared toward the needs of the energy industry" (Survey responses, p. 3). Each of the certificate and degree programs has an established industry advisory committee which "alone accounts for a number of significant employers" (Survey responses, p. 3) who dedicate time, talent, and financial resources to strengthening the degree programs.

The development of degree programs and offerings at BSC has been consistently responsive to the expressed needs of local industry and employers who work collaboratively with the college and with each other. As an example, BSC faculty shared a story related to a local plant managers group that meets three or four times a year. Despite the fact that these individuals are competitors, they have found ways to come together to share resources (e.g., plan outages around each other to avoid a shortage of skilled workers) and to project workforce needs. When this plant managers group projected workforce needs in three areas – mechanical maintenance, instrumentation and control, and welders – BSC responded by creating two new degree programs and expanding another to suit industry needs. The result is viewed as a "win-win" for everyone involved. The industry partners experience their needs being met and are encouraged to continue to partner with BSC, and program graduates find jobs upon completing their degree in areas that are in "high, high demand" (EHN1, p. 13).

Industry advisory members that we spoke with echoed this sentiment of their being a strong and beneficial partnership between the BSC and employers. For example, one industry advisor shared that:

> Back around 2000 or so, we organized people from both the power industry as well as the oil and gas, and started looking around at what was being taught and what was missing and where we're going to have shortages.
>
> Particularly at that time, what we did was we recommended both Bismarck State College and other colleges in the southeastern part of North Dakota (called Wahpeton or the North Dakota State College of Science) expand a *welding program* because of the big shortage of welders we're starting to see. The creation of an *instrumentation and controls program*, which all of our equipment is being operated by, PLCs and other type things. And there didn't exist anything in the State of North Dakota like that. And we also recommended a *mechanical maintenance* program. There were no courses being taught on rotating machinery, valve maintenance, hydraulics, different things like that.
>
> These are the things industry needed, and Bismarck State College was very responsive, and it's been a great partnership because we have gone ahead and industry has really kicked in a lot of money to help them. (Employers, p. 3)

This partnership continued into determining the curriculum for the BAS in Energy Management degree, as well as providing financial support to both provide a foundation for the degree and to finance students' pursuit of the credential.

Beyond the existing industry advisory committees, there are a number of local and regional employers (e.g., Basin Electric, Great River Energy) who have engaged in long-term partnerships with BSC and the NECE. More recently, national partnerships have extended the reach of BSC's programs. For example, the Energy Providers Coalition for Education (EPCE) was formed in 2001, and they selected BSC as their "founding education provider" (Survey responses, p. 3) for leadership in the area of both degree programs and non-credit offerings. Today, EPCE includes approximately 30 utilities and organizations from across the country.

As a part of these partnerships, employers have made numerous financial and resource contributions to the NECE programs at BSC over the years. For example, one Industry Advisor described how BSC students benefit when equipment is upgraded at local power plants, saying:

> We go through our outage in June. We will invite Bismarck State to come over with a nice truck and a nice flatbed and pick up all the old equipment that we have that they could use or replace it here and go ahead and use it to teach students. … The students get to see the equipment that they're actually going to be working on once they leave here and go out to the plants. (Employers, p. 6)

Others described how their organizations contributed to the creation of the learning spaces. For example, one Industry Advisor shared the following about his organization: "Take this building here. Basin Electric contributed $2 million to this [and] the walls are made out of fly ash from our power plant" (Employers, pp. 6-7).

Deep and Long-Standing Investment. One characteristic of the college-employer relationships that is difficult to overlook at BSC is the deep and long-standing nature of the relationships that have been developed between the degree programs and industry. Industry has deeply invested in the degree programs that the NECE in a variety of ways – financial, political, human resources, and so on. These deep and various partnerships are evident in the following reflections from an Industry Advisor:

> I would say probably at the power plants, probably 75% of our people are 2-year degreed. And I would say the vast majority have been through one of the programs here. And they come with a very – We know them in terms of the quality of the education they're getting. We know that they're going to come with some good backgrounds. They have trained on equipment we use.

> An example is, we're just installing – Well, we're just finishing testing a simulator that's here. Our company contributed over a million dollars to get that system designed and built. It's an exact replica of the control system we have at our power plant, but it's beneficial for all the other plants even though it's not the same control system, you know, teaching the integrated operations and how you start up and shut down systems and how you deal with certain disturbances there. That's all being done. So it's been a really good partnership.
>
> In that case, that's just an example of the simulator. The simulator instructor who teaches that program, who works for Bismarck State College, was an 18-year veteran in our control room. So this guy knew how to run a power plant. So [name], he served that role, and he's been the simulator instructor for over 10 years now. And so, he has a good knowledge. A lot of the people who are teaching the programs around here come out of industry, and so, you know, they have a very good practical knowledge of what we need. (Employers, p. 3)

These Industry Advisors and other contributing employers have a considerable stake in seeing the degree programs at NECE succeed.

Student and Faculty who are Professionals. The BAS in Energy Management relies on "a high enrollment number of incumbent employees… a lot of people are very experienced [and] give a lot of feedback in the program" (EHN2, p. 11). They bring their experience with evolving technologies and industry standards to the classroom.

Program administrators and faculty members spoke about how this enhances the classroom experience and the program as a whole. For example, one faculty member described his experiences with students as follows:

> One of the things that keeps this program as dynamic as it is, is that we have – I have students on one end that have 10, 15, 20, even 30 years' worth of experience, and on the other end, I have students that have no experience. They come straight out of the AAS, and we get into discussions.
>
> We have some very up-to-date input into those discussions. And these guys, they actually – I enjoy being in the discussions because they not only – They inform me a lot of what's going on, and it keeps me current. But it also brings these younger students up to standards and up-to-date types of things, but the problems these guys experience informs whatever course I'm taking.
>
> So the students themselves in this case are really what keeps the quality of classes up. I mean, I've always said they teach me 99% more than what I teach them, because these guys really are out there in the field. They're experiencing it first hand, and I'm just an academic now. (EHN2, p. 11)

In addition, there are approximately 6 to 10 adjunct faculty members who teach in the program each have "15 to 20 years' worth of experience in the industry itself" (EHN2, p. 12), and most of them have master's degrees as well. Adjunct faculty members are sought out for their specialized knowledge and "can be spread out all of the country" (EHN2, p. 12) since the program is offered online. The variety that they offer is what is thought to "keep the courses current, vibrant" (EHN2, p. 12).

Foundation and Grant Writing. The program administrators and faculty in the NECE work closely with two grant writers in BSC's Foundation to prepare federal and state grant submissions to develop new online teaching materials, equipping laboratory space, etc. As one program administrator reports, "we've had some pretty good success" (EHN1, p. 19) with grant opportunities such as the state's North Dakota Department of Commerce workforce enhancement grant which usually reserves approximately $2 million per year for community colleges throughout the state to apply for funding assistance for developing programs, purchasing equipment, etc. which requires matching funds from industry.

Professional Associations and Boards. In 2000, the Energy Providers Coalition for Education (EPCE) was formed. EPCE is "a group of representatives from the energy industry that develops, sponsors, and promotes industry-driven, standardized, quality online learning programs to meet the workforce needs of the energy industry" (http://epceonline.org/about-epce, Retrieved September 12, 2013). BSC became an early partner in the EPCE coalition, with early projects focused on developing online college degree granting programs for the energy industry specifically the transmission and distribution of power (T&D), as well as nuclear power production.

K-12 Outreach. The Bismarck Public Schools Career Academy is located on the campus of BSC. BSC uses 40% of the building, and the remaining 60% of the space serves nearly 1,000 students from Bismarck-area 9 public and private high schools (http://www.btc.bismarckschools.org/techcenter/about-our-school/, Retrieved September 12, 2013). Students who recognize that they are interested in a technical career path by their sophomore year in high school can get a considerable jumpstart on their education. They can complete a sequence of electronics courses in high school and transfer as many as 28 college credits to BSC, allowing them to start their college courses in the second year of the telecommunications or instrumentation and control degree programs.

Sharing What Works: Educational Significance

Economic and employment needs. The BAS in Energy Management was developed due to address a recognized need in the energy industry for qualified supervisors and managers. The energy industry faces a dual challenge of "ever-increasing demand for energy and the growing need for highly trained energy workers who seek advancement in their career" and a number of positions that are "soon to be vacated by a large number of retirees" (BAS Brochure, 2012, p. 2). Growth continues across the board in all sectors of the energy industry. Water and waste water systems and services were projected to grow 13% in the next decade (BAS in Energy Management brochure, 2011, p. 1, http://www.bismarckstate.edu/uploads/resources/155/energy-management.pdf). As of 2008, workers age 45 or older comprised 53% of the utilities industry signaling expectations for a large number of job openings due to retirements in the near future. The BAS in Energy Management degree program provides preparation and training for leadership positions, so that graduates of energy-related diploma, certificate, or associate degree programs who also have work experience may be ready for successful career advancement.

Industry Advisors also shared that an associate's degree was now a basic condition for entry-level position in the energy industry – "I don't think we're even looking at anybody [without an associate degree]" (Employers, p. 7). However, some Industry Advisors that we spoke with indicated that there was a need for associate degree holders to distinguish themselves from the crowd. One approach to do this is to gain multidisciplinary experience. As one Industry Advisor described:

> Sometimes they'll come through the program and they'll maybe do a instrumentation degree and a technology degree. Because we'll use our people interchangeably, and they just have much broader background... We're looking for that well-roundedness that will really help out in the plant environment. (Employers, p. 7)

Completing a BAS degree was viewed as a second way for students and graduates to set themselves apart from the crowd. One Industry Advisor shared the following reflections on the advice that he shares with students about planning for their future careers:

> We'll talk to them about "Okay, what are you bringing us when you come for an interview? What's in your toolbox?" Everybody has a 2-year degree, but what else do you have?

> Some of our equipment operators have a 2-year degree in power process. What better person to have as a heavy equipment operator working for us that has a 2-year degree in power process? An instrument tech person that can talk to an operator about power process. We're starting to see some of that.
>
> And then, we also saw that with the BAS program. Okay, so, when we started hiring people, going through bunch of resumes, and one thing I'll see, everything is standard, a 2-year degree. That's fine. Okay, here's my work, but also underneath that 2-year degree, I will be looking for BAS. When that BAS comes up, what better person to have come work with me, that understands the industry a little bit more from a – They've got the technical. Now, what do they know about the management of running a refining business? So if they know that or if they've got some inkling of that, I don't have to bring that back up here to them. So I'm saving money. I'm getting a better quality person, a better tool to run the refinery. It's what they're bringing to us as far as their tool bag, and that's what I see. (Employers, pp. 5 – 6)

Industry Advisors that we spoke with perceived that "This country is undergoing a revolution in energy right now that most people don't even understand how huge it is. And we may go from a point of importing energy to actually being an exporter of energy" (Employers, p. 8). These individuals expect that the energy industry will bring with it "some very, very large job opportunities for very well-paying jobs" (Employers, p. 8). However, the majority of these jobs will not be for individuals with four-year degrees; they will require two-year technical degrees. Where the BAS degree fits in is that "somebody's got to manage all of this" growth and activity (Employers, p. 9).

When reflecting on who has traditionally been called to management positions, Industry Advisors reflected on a mismatch in acquired and needed skills. As shared by one Industry Advisor:

> The one comment that I remember hearing someone say is "I don't know why they keep hiring us engineers for supervisors. Just because we can do math doesn't mean we can supervise." …
>
> Most of the people I am involved with who are in management or supervisory positions have come through the ranks and don't have a business background or enough of a business background to be able to really do the budgeting, understand the energy economics that are influencing what's going on out in the industry. And the more that you have knowledge of that sort of thing, which is in [this BAS program], the knowledge of regulations, you learn it the hard way in our industry. And we would just as soon teach it to them at an early phase. (Employers, p. 9)

Industry Advisors generally agreed that "very, very few people" (Employers, p. 10) without a four-year degree obtain management roles without a four-year degree, however it seems that the skills set from traditional four-year engineering degrees leave skill gaps in key areas of business management, supervision, and knowledge of the energy field that have been targeted in the design of the BAS curriculum. As summarized by one Industry Advisor: "I think if we can offer them the opportunity to get the background you'll see in the curriculum for the BAS, I think it really helps them out. It gives us as, I would say, company leaders to go ahead and pick people with that kind of a background" (Employers, p. 10).

Academic and learning needs. Brochures for the BAS in Energy Management degree program describe skills needed for individuals to move into leadership positions within energy-related fields that are beyond those taught within typical certificate, diploma, and associate degree programs. These skills sets are described as follows:

> Managers in the energy industry plan, organize, direct and coordinate company activities. They are often responsible for negotiations with government regulators, labor unions and suppliers. Today, companies place greater importance on a candidate's interpersonal skills. Production managers must be well rounded and have excellent communication skills and the ability to compromise, persuade and negotiate. Industrial managers must keep informed about new technologies and management practices. Many belong to professional organizations and attend trade shows or conferences to keep up to date. Strong computer skills are essential.
> (BAS in Energy Management brochure, 2011, p. 1, http://www.bismarckstate.edu/uploads/resources/155/energy-management.pdf)

The energy management course sequence is designed to teach management, leadership, and supervision skill set within a framework that is highly related to the energy industry environment.

Instructional Pedagogy.

Online instruction. All courses for the BAS degree are offered in an online format. This online format was initially designed to reach the population of students with in a 70- to 80-mile radius of the BSC campus who work at regional power plants and refineries and could not travel to campus for regularly scheduled class meetings. However, once the program is placed online, the decision to extend it nationally was made "on the basis of cost" (Employers, p. 18). The online nature of the program no longer restricted students or instructors to a specific geographic location, and program administrators found that opening enrollment to a broader geographic base helped to "pay for the program" (Employers, p. 18).

The 10 core energy management courses are all offered in an asynchronous, 8-week format. General education courses are offered online in 8-week or 16-week formats. One program coordinator who advises students in the BAS degree program shared that "students tend to prefer the shorter courses" (EHN2, p. 6). This is because students who are coming out of the associate degree programs at BSC are accustomed to short courses – some as short as only 3- or 5-weeks.

A chat room feature is provided, with optional scheduled meeting times for instructors to be available to provide one-on-one guidance. Chat rooms do have a number of tools to enhance interactions, such as chalkboards where instructors can draw examples and workspaces for problem solving. Chat room sessions are recorded and archived so students who are not able to attend may observe the interactions at a later time.

The asynchronous nature of meeting times and optional chat room features are viewed as necessary for the student population that the BAS in Energy Management degree serves. As the program faculty members explained: "A lot of students work in industry. A lot of energy jobs are shift work jobs. They're not 8:00 to 5:00 jobs" (EHN1, p. 23). Furthermore, students' schedules often change from one week to the next. One faculty member shared some shift examples. One example was referred to as "four-twelves," where individuals work four twelve-hour days in a row, then are off for four days, and then are back on for four twelve-hour days. In another example, workers are on 2 days, off 3 days, on 7 days, off 2 days. As a result, students are not available on the same day each week for classes. Additionally, students in the degree program come from all across the U.S., joining from different time zones that further complicate collaborative work and class meeting times. One program administrator described early attempts to bring students together as follows:

> But early on, in the power plant program, remember we tried to have some mandatory group projects online? It was a disaster just because we've got students in different time zones… A lot of energy jobs are shift work jobs… So when one was doing the work, another student wasn't. We ended up doing away with the group projects, for the most part. It's pretty much on your own with a lot of time for discussions and stuff. No group assignments. (EHN1, p. 23)

For reasons such as these, the BSC faculty determined that the self-pace, online learning environment is the only medium that makes sense for this working student population who are balancing shifting work scheduled with family demands and school. The employers, many of whom are financially supporting students enrolled in the degree program, understand and are supportive of the choice of the education delivery format.

The Industry Advisors shared that one of the benefits in focusing on an adult working population in this online environment is that students bring their industry experience into the classroom – "they can relate the theoretical of what's being taught to practical applications within their job setting" (Employers, p. 11).

Courses are developed collaboratively with a team of faculty members and computer specialists who can build animations and simulations. This partnership was described by one program administrator and faculty member as follows:

> The faculty work very close with [the computer specialists] to try to build these different technical pieces of equipment or systems, how they work. Years ago, we tried to train faculty how to build some of these. It was a disaster. I was right there with them, I was like are you kidding me? I learned quickly, you need to get some computer specialists. They have no clue what energy is, but the faculty work with them one on one. Submit a ticket to build this pump, make it do this, make it do that. What they build is amazing, even 3-D stuff right now. We've got a 3-D water plant, a 3-D wind turbine. It's really amazing what they can do. (EHN1, p. 11)

Supports provided to help students achieve positive results and outcomes.

Academic Advising. Students are encouraged to visit with their academic advisors prior to registration in the BAS degree program, and prior to course selection each term to seek advice on their individual educational plans (BAS Brochure, 2012; http://energy.bismarckstate.edu/programs/enrg/cs/, Retrieved March 22, 2013). Four energy advisors are dedicated to online degree program students, with one individual designated to coordinate the BAS degree program (EHN2, p. 7).

Financial assistance. BSC has established the BSC Foundation, which budgets more than $350,000 in scholarship awards to over 350 students, available to both incoming freshmen and sophomores. Scholarship awards generally range from $500 to $2,000 annually. One scholarship opportunity in particular is reserved specifically for students in the online BAS degree program in Energy Management. This scholarship offers $500 paid per semester to a total of $1000. Eligible students must have a minimum grade point average of 3.0 and enroll in 6 credits per semester. The deadline to apply is September 1 each year.

A few students apply for Pell grants. However, the "majority of [students] work in the industry, and they get tuition reimbursement form their employers" (EHN2, p. 8) for the BAS in Energy Management degree program. In fact, the program coordinator reported that it is not unusual to see students who have completed their associate degrees decide to "intentionally just sit out for 6 to 12 months until their tuition reimbursement kicks in with their employer, and then come back and complete the bachelor's degree, just because the cost isn't on them then; it's the employer who'll pay for it" (EHN2, p. 8).

Career assistance. Within classes, there is little discussion about job searching and career exploration. As one faculty member explained, this is tied to the fact that most students in the BAS degree program have their tuition reimbursed by their employers. As such, faculty members are in an awkward space for public discussions of career movements – "companies don't normally like to reimburse for instruction and then have [their employees] move on to another company" (EHN2, p. 15).

However, advisors for the BAS degree program report that they are often approached by students who have career advancement in mind. As one advisor shared:

> I do hear a lot of students who will call and inquire and say, you know, "My HR department came to me," or "My supervisor came to me and said, you know, I need to get a 4-year degree in order to be eligible for the next, you know, step in the promotion process," or "I have a coworker who is doing this program, you know, and I wanted to look into it myself." (EHN2, p. 15)

Sharing What Works: Evidence of Effectiveness and Success

Challenges to gathering evidence of success. One program administrator shared that, as is "typical of two-year colleges" Bismarck State College struggles to get graduates to "join the alumni association and to keep their information accurate" (EHN2, p. 15). This makes it very difficult to seek out information on individuals after graduation to understand the outcomes of their college experiences.

Evidence offered as a demonstration of success.

Recognition of the institution from external sources. In 2007, BSC was designated as the National Power Plant Operations Technology and Education Center by U.S. Energy Secretary Samuel W. Bodman. This designation recognizes the institution as "the premier national center of education and training for operators and technicians in the energy industry" (BAS in Energy Management brochure, 2011, http://www.bismarckstate.edu/uploads/resources/155/energy-management.pdf).

Employment and continuing education rates. Data from the 2010-2011 and 2011-2012 BSC Counseling and Career Services reports demonstrate that, based on survey responses, 97% of BAS in Energy Management program graduates find employment or continue their education following their completion of the degree program (See Table 6). Of those that find employment, the majority (80%) find related employment out-of-state. Few employed graduates (5%) find work in positions unrelated to the BAS degree. This is perhaps aided by the situation that "the majority of BAS in Energy Management students are already employed in the industry before they enroll in [the] program" (Survey responses, p. 2).

Of the 64 graduates who responded to the surveys in these two academic years, 9% stated that they are pursuing continued education. In a focus group with three graduates of the BAS degree program, two shared that they had gone on to pursue an MBA degree. For one graduate, the MBA program accepted his BAS degree in total – "I didn't have to do any pre reqs. going into the MBA program" (Graduates, p. 3). The other gradate had to repeat a single course in finance because the BAS degree course was "geared towards energy" (Graduates, p. 10) and her graduate institution would not accept it.

Table 6. Employment and Continuing Education Outcomes for BAS Degree Graduates in Past Two Academic Years

Year	Total Graduates	Number of Responses	Continuing Education	Related Employment In-State	Related Employment Out-of-State	Unrelated Employment	Unemployed	Salary Range Per Hour	% Employed / Continuing Education (Based on Responses)
2011-2012	43	35	5	4	21	3	2	$25 - 48	94%
2010-2011	32	29	1	4	24	0	0	$26.70 - 37	100%
Total	**75**	**64**	**6**	**8**	**45**	**3**	**2**	**$25 – 48**	**97%**

Post-graduation information on employment trends described by faculty and employers. Program faculty and administrators shared that BSC's strong national reputation stemmed from the mid-1980s when graduates began leaving the state to find work. As one program administrator shared:

> A lot of these plants jobs are very good jobs. People don't leave. So when the plants got pretty full in the mid-'80's, most of the students were migrating out to find work. And if you wanted to find work, you could; there were always jobs in this field because it's kind of a unique program…
>
> We have grads working in every state now that have gone through one of these programs. So it's all over the country. It's really been word of mouth that got us out in the market. And if we get students out of Kansas, it's probably because they know someone in Kansas who went here and eventually moved to Kansas and now they take classes online. It's really grown over the years, has a nationwide presence now because of that. (EHN1, p. 5)

An Industry Advisor also shared stories of two program graduates at his organization, sharing that each had been promoted to supervisory and management positions following their completion of the BAS degree program. The reasons for the promotions are multifaceted – "we look at the person. We look at the experience the person has and the knowledge they have" in total (Employers, p. 11). However, the fact that they had completed a four-year degree and the knowledge that they brought from that experience "played a little bit into" the promotion decisions (Employers, p. 11).

Post-graduation information from student stories. The NECE Facebook page includes "Student Success Stories as a way of highlighting the experiences of graduates and marketing the degree programs. Here is an example of one such success story (the name of the student has been replaced with a pseudonym for the purposes of this research report):

> Jane Smith began her career in the energy industry as a receptionist for the Burlington Resources Lost Cabin Gas Plant located in Lost Cabin, Wyoming. Smith then moved into the Mechanical Integrity Assistance position and heard about BSC's Process Plant Technology program from several Lost Cabin Gas Plant operators that were previous and current students.
>
> While attending BSC, Smith was successful in acquiring an Engineering Technician/MOC Coordinator position with Burlington Resources (ConocoPhillips). Smith says the completion of BSC's Process Technology program also helped her gain her current role of (PSM) Process Safety Management/(MOC) Management of Change Coordinator with the Wind/Green River Area for Encana Natural Gas.
>
> "The online curriculum was the only way I was able to attend college. The reliability of the online courses and the instructors were beyond my expectations. The instructors were very organized and structured. I feel that BSC helps give a well-rounded curriculum for anyone entering the industry. My previous experience was very valuable but having both experience and education has been tremendously enlightening," she said.
> Smith said she would advise anyone considering a degree in the process industry to enroll at BSC. "What are you waiting for?" she said. "It doesn't matter whether you are new to the industry or have been working in it for a while. These courses are very pertinent to all facets of a plant operator and other industry roles. BSC is also very helpful with future placement with very reputable companies within the industry."
> Congratulations, Jane!

The Facebook page (https://www.facebook.com/bscnece) is also used to announce events (e.g., career open house programs), new program offerings (e.g., the addition of online courses), new transfer relationships (e.g., the articulation agreement with Salt Lake Community College), academic deadlines (e.g., when course registration begins), and community outreach events, and so on. The Facebook page has been active since November 2009.

Feedback from employers. Industry Advisors were asked to reflect on the strengths that they observed students gaining from the BAS degree programs. While recognizing that the BAS degree was still relatively new making outcomes challenging to determine, they shared the following perceptions (Employers, pp. 12 -13):

- Probably being able to supervise better, manage the job that they have – are probably the two biggest things.
- Our supervisors at a very low level are being exposed a lot to budgeting and budgets and understanding what capital means versus what operations and maintenance budgets mean.
- A little bit more of the management ethics side of things, where now it starts driving home a little bit more of really what a business is about. We are a part of the community. We are a part – a working relationship with the union.

Descriptions of evaluation efforts.

College-wide assessment efforts. Approximately one year ago, BSC received at Title III grant designed to increase their "use of data in decision making" (Assessment, p. 1). As a part of this grant, a new Assessment Coordinator position was created to focus on outcomes assessment for academic programs. Guidebooks were created to help faculty to develop outcomes statements at the course and program level, incorporating Bloom's Taxonomy, as well as example assessment strategies and reports. Two separate guidebooks were produced – one for technical programs and one for liberal arts degrees – because of the differences in the assessment process for the two program types. The campus had purchased the TrackDat

software for compiling assessment data approximately 3 to 5 years ago, however, they are "only recently are trying to ramp up the efforts of getting all the information in [the system]" (Assessment, p. 1). In the early years of having the system a few "assessment champions" on campus have used it well, but other departments have lagged behind. The recently-hired Assessment Coordinator will take on the role of bringing all academic departments to an agreed-upon base level of assessment progress and reporting in the TrackDat software. At the time of our site visit in April 2013, the Assessment Coordinator reported that the work for bringing academic departments together on outcomes assessment activities had just begun – "We just had our initial meeting a couple of weeks ago and had people submit the outcomes and things, and discussed the difference between a program outcome and a course level outcome" (Assessment, p. 2).

Program review. A variety of assessment strategies are engaged for program review. Each term, program administrators and faculty track student enrollment, demographics, and retention, as well as monitor course completion and grades. An annual survey of program graduates is also administered.

CYBERWATCH CENTER AND PARTNER APPLIED BACCALAUREATES

This section presents case studies conducted in four organizations associated with the NSF ATE Center called CyberWatch. The cases involve the CyberWatch Center, Prince George's Community College's Associate of Applied Science (AAS) in Information Security, the University of Maryland-University College's Bachelor of Science (BS) in Cybersecurity, and Wilmington University's Bachelor of Science (BS) in Computer and Network Security.

The CyberWatch Center

In October 2005, CyberWatch was founded as an NSF-ATE Regional Center to serve the Washington, DC metropolitan area. It was one of three ATE centers focused specifically on information assurance education. (The other two included the Center for System Security and Information Assurance at Moraine Valley Community College in Illinois and the Cyber Security Education Consortium at the University of Tulsa in Oklahoma). Originally, the core membership of the CyberWatch consortium was made up of 10 institutions in Maryland, Virginia and the District of Columbia (NSF-ATE Award Abstract 0902747). CyberWatch endeavored to "increase the quantity and quality of the information assurance workforce… [by] improving information assurance education at all levels: high school, associate, baccalaureate, and advanced degree levels" (http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=50&Itemid=29&limitstart=1). CyberWatch set goals in several areas to help achieve this broad mission: curriculum development, professional development, student development, career pathways, dissemination and outreach, and sustainability. Table 7 provides examples of specific initiatives that aligned with these goal areas.

Table 7. CyberWatch Goals and Example Initiatives*

Goal	Initiative
Curriculum Development	• Developed model curricula for an Information Security A.A.S. Degree, an Information Security A.S. degree, an Information Security Certificate, and an Information Security Management Certificate. • Based the model curricula on the 4011 and 4013 standards established by the Center for National Security Standards (CNSS). • Assisted member colleges with mapping their own curricula to meet the 4011 and 4013 standards. • Facilitated the development of articulation agreements from the Information Security / Information Assurance programs at community colleges with baccalaureate degree programs at 4-year institutions. • Led the initiative to establish a CAE designation for community colleges.
Faculty Development	• Ran an extensive Information Security Faculty Development Program to prepare faculty to teach the courses in the Information Security / Information Assurance curriculum. Faculty from all member institutions were eligible to attend. • Sponsored a Faculty Graduate Program, providing financial support for taking courses in information assurance at accredited graduate institutions.
Student Development	• Conducted three student competitions each year: the Mid-Atlantic Regional Collegiate Cyber Defense Competition, the Security Awareness Contest, and the Digital Forensics Challenge.
Outreach and Dissemination	• Offered a variety of K-12 programs, such as: ▪ Cyberethics, Cybersafety, and Cybersecurity (C3) Conference ▪ Cool Careers for Girls in Cybersecurity Workshops ▪ The Young Scholars Program: Students, Learning and Technology ▪ Teacher Cisco Academy Training Program ▪ Guidance Counselor Workshop ▪ 2+2 programs with high schools ▪ New high school level competitions ▪ Security Awareness Day, Cybersecurity Club • Facilitated a Speakers Bureau, as well as presentations at academic conferences, government agencies, and industry associations • Disseminated newsletters, news articles, and reports

*Primarily Drawn from CyberWatch Website - http://www.nsf.gov/awardsearch/showAward?AWD_ID=1204533&HistoricalAwards=false.

A Phase II NSF-ATE grant was awarded to CyberWatch in 2009 to continue and expand upon their initiatives. Since then, the membership of participating institutions has grown to 99 institutions (52 community colleges and 47 universities) across 31 US states (Alaska, California, Colorado, Delaware,

Florida, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia and Wisconsin) and the District of Columbia (http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=82&Itemid=161). Further confidence was demonstrated in the accomplishments of the CyberWatch Center, with the recent award of NSF-ATE funding in September 2012 to broaden the scope of these efforts to develop a CyberWatch ATE National Center of Excellence. Looking forward, CyberWatch will be called upon to "[lead] the effort to bring cybersecurity education at community colleges to the forefront of the national dialogue, thereby helping employers across the nation to meet a critical workforce need" (http://www.nsf.gov/awardsearch/showAward?AWD_ID=1204533&HistoricalAwards=false).

Definitions

CyberWatch recognizes that a variety of terms are used to describe the field of study and practice in which it operates, including: information assurance (IA), information systems security (ISS), information security (IS), cybersecurity (sometimes spelled "cyber security"), computer security, and information security/information assurance (IS/IA). These terms are often used synonymously, yet they can have slightly different meanings. CyberWatch has chosen to generally use the term "Information Assurance" (IA) based on the way that this term is used in related literature and this term's use by the Center for National Security Standards to designate high-quality educational institutions in the field – Centers of Academic Excellence in Information Assurance Education (CAE/IAE, http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=50&Itemid=29&limitstart=4).[1] We really have chosen Cybersecurity from here on out in place of Information Assurance

Core Components of the CyberWatch Approach

When engaging with CyberWatch Center leadership, two core constructs emerged repeatedly as cornerstones to the success of their approach to developing a strong cybersecurity consortium. They spoke of the importance of (1) building broad and open collaborations, and (2) quickly establishing and distributing a model associate degree curriculum in information assurance.

Collaboration. As described by the original CyberWatch PI and Director, NSF-ATE Centers each "take on a life of [their] own, and they become shaped, and they are shaped differently… our Center seemed to have this whole aspect of collaboration, working together" (VZ, p. 1). The Center started with 10 core institutions, 5 community colleges and 5 universities, working across institutional and state boundaries to enhance the cybersecurity workforce through faculty development, student development, curriculum development, and dissemination of information. Quickly the objective of collaboration spread to a goal of helping others build and strengthen collaborative models in other locations. For example, CyberWatch helped institutions in the State of New York build partnerships to further cybersecurity education, as well as helped a group of institutions in the States of Washington and Oregon to achieve similar purposes. The CyberWatch team firmly believes that:

> Strength is in numbers, and strength is in collaboration. They really cannot … get a successful project by just one institution. It doesn't make sense. Because by collaborating your strengths in what you already have, and by collaborating with 4-year institutions, … you get this symbiotic relationship with faculty-to-faculty conversations between 2- and 4-year and 2- and 2-year. (VZ, p. 2)

It is in these intersections between institutions and partners that CyberWatch leaders say they have observed the greatest progress in cybersecurity education.

[1] Feedback from the CyberWatch Center indicated that ultimately, the term cybersecurity was the preferred venacular.

The role of CyberWatch in establishing these collaborations is very much that of an initial catalyst, fueling the initial connections and then stepping back and expecting the relationships to develop on their own. One senior CyberWatch leader describes the experience establishing collaborations among institutions in new regions of the country as follows:

> One of the objectives in the National Center is to actually help others and strengthen collaborations and build collaborative models elsewhere. [This is accomplished in two steps.] One is active encouragement, and two, is making it clear what the advantages of collaboration are.
>
> I think oftentimes people don't think about it. It's not that they do not want to collaborate. They don't – "it's not something I think about." But if you tell them and if you suggest and if you say, "Hey, you know, maybe if you have this – I don't know – camp for kids or whatever, you can work with that college, and maybe they have faculty who can work here. Maybe they can send kids here." You know, this cross-pollination. And once that starts, it's amazing. You don't have to do anything anymore. That's what I've found, that once you plant the seed and they take that first initiative and they start any kind of collaborative project, from what I have seen, is that those collaborations tend to grow and to expand and to flourish.

Moving forward, CyberWatch Center leaders aim to continue to provide "a forum for collaboration" (VZ, p. 11) bringing educators, employers, and other partners together to share expertise and work toward a common goal. CyberWatch contributes to "synergy and an effort building [connections] between people; a human effort."

Model associate degree curriculum. Beyond providing the initial catalytic spark for collaboration through personal connections, there was also a consistent recognition of the value that CyberWatch has provided in terms of a strong foundation for curriculum development. When CyberWatch was established in 2005, Anne Arundel Community College (AACC) was the only associate degree-granting institution in the State of Maryland to have a degree in information assurance or cybersecurity. Working with the faculty and administration at AACC, CyberWatch adopted their curriculum as a model program. This was "an early feather in [CyberWatch's] cap – it put [them] on the national map" (COB, p. 1) because no other regional cybersecurity center had a comparable resource to offer. The adoption of the AACC degree program is an essential part of the CyberWatch story because it facilitated three important follow-up actions.

First, approval of the CyberWatch model AAS degree program in information assurance by the Maryland Higher Education Commission (MHEC) was greatly eased by the association with the already-approved AACC degree program. Since CyberWatch was adopting this program directly, it was "pretty much a rubber stamp process… it was easy for [CyberWatch] to get MHEC approval" (COB, p. 4). The same would be true for other community colleges in the State of Maryland because CyberWatch set a basic threshold of saying that:

> 75% of the model degree program is identical across all of the member institutions that adopted that. 25% variability allows for local needs. … The fact that everybody was teaching roughly 75% of the content made getting MHEC approval easy, [and] made our articulations really easy for CyberWatch to sit at the table. (COB, p. 4)

This leads to the second occurrence, which was rapid adoption of the CyberWatch model AAS degree program by numerous community colleges across the State of Maryland (as well as beyond Maryland's state boarders). Not only did the adoption of an established model curriculum facilitate state board approval in Maryland, it offers other time- and resource-saving benefits. The strong foundation that the CyberWatch model program offers significantly decreases the investment of faculty time and resources that any single community college needs to make in order to develop a new AAS or AS degree program (VZ, p. 10). The investment made by interested community colleges then becomes a focus on infrastructure and faculty professional development and training to offer the curriculum. In the experience of CyberWatch administrators, colleges are willing to make this type of investment and to "jump on the bandwagon" when the curriculum foundation is provided (VZ, p. 11). Just in Maryland, information assurance associate degree

programs have "started popping up like mushrooms" (VZ, p. 10) in the seven years since the establishment of CyberWatch, with at least 12 of the 16 public community colleges across the state now offering these degree programs based on the CyberWatch model curriculum. One administrator proudly explains the impact of CyberWatch, stating that: "CyberWatch preceded all the programs in the state except one. All the mappings (of courses to CNSS 4011 and 4013 standards) except one. All the CAE2Ys. That's what CyberWatch has done" (VZ, p. 10).

Finally, the CyberWatch AAS degree model curriculum also provided the CyberWatch consortium with a strong message to share with baccalaureate degree-granting institutions. As described by the Director of CyberWatch:

> CyberWatch as a consortium [could] sit at the table with [bachelor's degree-granting institutions] like [University of Maryland-University College] UMUC, for example, and say, look, we've got this many members in our consortia; they're all teaching roughly 75% of the same content. So let's sit down and talk about articulation agreements between UMUC and CyberWatch as opposed to individual institutions sitting down. (COB, p. 1)

A matrix is created in which community colleges map their courses to the CyberWatch course designations. Then, a bachelor's degree-granting institution can create an articulation agreement to CyberWatch course designation, thereby significantly decreasing the amount of time needed for negotiations between higher education institutions (a single articulation between CyberWatch and a bachelor's institution, rather an a different articulation for the bachelor's institution with each community college in the CyberWatch consortium). This matrix mapping process has been in place roughly since 2006.

CyberWatch organization. The CyberWatch organization is made up of member higher education institutions, partner businesses and governmental agencies, and a volunteer advisory board. Together, these groups work to "improve the quantity and quality of the information assurance (IA) workforce… [by collaborating to] share best practices, methodologies, curricula, course materials and modules, and provide faculty training and support to institutions that want to develop an IA curriculum" (http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=110&Itemid=53, para. 1).

There are many reasons that organizations choose to partner with CyberWatch. Public and private sector partner employers often see their engagements with CyberWatch as a strategy "to get access to talent" (COB, p. 6) so they may hire up-and-coming professionals in the field. Working with an organization like CyberWatch can provide reach into several 2- and 4-year higher education institutions in one location, thereby offering an efficient recruiting strategy. The two main drivers for academic institutions to partner with CyberWatch include access to the model curricula and assistance with mapping to the CNSS 4011 and 4013 standards. Those immediate needs for developing 2-year degree programs in information security draw institutions in – "that's the main thing people want" (COB, p. 3), making it an important offering for CyberWatch to be able to actively engage new academic communities. With time, then the higher education institutions begin to "see all of the various other offerings that [CyberWatch] can provide – faculty development, access or the ability to compete in cyber exercises, K-12 initiatives, help with articulation agreements" (COB, p. 3-4) and a potential for longer-term involvement emerges.

Membership in CyberWatch is currently "free and open" (COB, p. 3). In order to join the CyberWatch organization as a member or a partner, all that is required is: (a) a support letter from a senior administrator to be submitted to CyberWatch, and (b) an institutional representative to be identified as a principle point of contact. All partners, members, and advisory board members are expected to actively contribute to the CyberWatch community by attending consortium meetings (approximately 4 per year, electronically or in person), sponsoring or participating in at least one program or activity, and participating in efforts to disseminate information about CyberWatch programs and events. The benefits and responsibilities of membership are presented with slight differences for each membership type, as outlined in Table 8.

Table 8. Benefits and Responsibilities of CyberWatch Participation by Membership Type*

Benefit	Higher Education Member	Organization Partner	Advisory Board
Assistance with curriculum development	X		
Assistance in mapping of courseware to the CNSS 4011 and 4013 standards.	X		
Assistance with the preparation of articulation agreements between 2- and 4-year colleges.	X		
Faculty development through sponsored trainings and the Graduate Faculty Program.	X		
Student development through a variety of programs.	X	X	
Internships, mentoring, and job placements.	X		
Student discounts on CompTIA certification exams, prep courses, and course materials.	X		
Models for interaction and programs with K-12 students/teachers/counselors.	X		
Presence at the CyberWatch website, newsletter, and reports.	X		
Associate membership in related-organizations, such as CompTIA, ISSA, and EC-Council.	X	X	X
Ability to participate in the CyberWatch Second Life Island.	X	X	X
Recognition through listing on the CyberWatch website, and all pertinent publications.		X	X
Opportunity to hire graduates for permanent positions and current students for internships.		X	X
Professional development opportunities through workshops/seminars/conferences.		X	X
Opportunity to become a CyberWatch Center, event, or program sponsor.		X	
Access to faculty expertise via consulting arrangements.		X	X
Invitation to participate as guest lecturer in courses/workshops/seminars.		X	X
Discounts on CompTIA certification exams, exam prep courses, and course materials.		X	X
Networking with other partners and academic institutions.		X	X
Dissemination through CyberWatch newsletter, reports, and website.		X	
Participation in shaping and updating information assurance curricula.		X	
Collaboration in grant proposals.		X	
Responsibilities			
Attend consortium meetings (~4 per year), electronically or in person	X	X	
Participate in a CyberWatch Committee	X		X
Participate in CyberWatch dissemination activities and events.	X	X	X
Share IA ideas and programs.	X		
Participate each year in at least one of the CyberWatch student competitions	X		
Actively sponsor or participate in at least one of CyberWatch's programs and activities.		X	
Attend and participate in CyberWatch Advisory Board meetings (approximately 2 per year)			X

*Based on data from http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=110&Itemid=53

At the time of our visit in March 2012, the CyberWatch website listed 50 partners representing a variety of organizations including community colleges, not-for-profit organizations, private industry, federal government agencies, state government agencies, county public school systems and districts, and government contracting agencies (http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=83&Itemid=162). The CyberWatch Advisory Board consisted of 28 individuals representing organizations such as community colleges, four-year public universities, not-for-profit organizations, private industry, federal government agencies, and government contracting agencies (http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=85&Itemid=160).

Degree Program Context

Model Curricula. CyberWatch has developed four model Information Assurance degree programs that are available to member institutions (Retrieved from: http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=57&Itemid=64). These include:

- Associate of Applied Science (AAS) in Information Assurance
- Associate of Science in Information Assurance
- Certificate in Information Assurance
- Certificate in Information Assurance Management

Model Courses. CyberWatch also provides eight model courses, including:

- CW 110 Ethics in the Information Age
- CW 130 Microcomputer Operating Systems
- CW 160 Security+
- CW 225 Hardening the Infrastructure
- CW 230 Microsoft Windows Server 2003
- CW 235 Network Defense and Counter Measures
- CW xxx Computer Forensics
- CW xxx Disaster Recovery and Risk Management

The first six courses are available to CyberWatch member institutions to download from the CyberWatch website (http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=57&Itemid=64

Comparing the AAS and the AS model curriculum. The CyberWatch AS model degree program was created several years after the AAS model degree program, as a modified version of the original AAS. The AS was developed primarily to address difficulties that students were encountering with transferring the degree to bachelor's degree programs by adapting the original model degree program to include the general education courses needed to fulfill the State of Maryland requirements for the Associate of Science degree. The differences are that the AS degree requires fewer technical credits, higher-level math, and more general education courses than the AAS degree. As a result of the changes, the AS degree is accepted in totality in transfer to bachelor's degree programs. The AAS degree program, on the other hand, is reviewed course-by-course, as bachelor's degree-granting institutions select which courses they will (and will not) accept for transfer. In most cases, students with the AS degree are advantaged in terms of the number of credit hours and courses that will transfer to a bachelor's degree program, as compared to the AAS degree program. This can even be the case when actual course differences between the AS and AAS degree program are minimal. One CyberWatch administrator stated that the curriculum changes between the AS and AAS degree programs

were "not an intentional difference, but a de facto difference" (VZ, p. 4). For students who enter the program with an intention to transfer to a baccalaureate degree, pursuing an AS degree makes practical sense because general education courses and higher-level math are more likely to transfer into a traditional bachelor's degree program – they essentially offer the student more flexibility than technical courses which may not be accepted by a four-year degree program. However, the AAS degree program was perceived as better suited to non-traditional student populations than the AS degree program. This administrator suggested that

> We have people who come with baccalaureate degrees in other fields, who come and take the AAS because they need all of these different technical courses and applied hands-on courses which they never had a chance to have and to learn. (VZ, p. 4)

Although data was not available to back up this claim, there was a sense that the AS degree might attract younger students, while the AAS degree might attract more mature, non-traditional students.

Another CyberWatch administrator expressed skepticism regarding the approach taken to create an AS degree program, stating that:

> I'm not sure that that's really a model that could work well because you end up having to reduce the number of technical classes to fulfill the Gen Ed requirements of the AS, so you're really watering down the applied portion of the degree obviously. … You lose the technical nature of the program. (COB, p. 2)

As is demonstrated in this example, a clear tension remains as educators seek to find the appropriate balance for the focus of the CyberWatch model curriculum. Should the focus be technical education preparing associate degree students for the workforce? Should the focus be preparing students for transfer to the baccalaureate degree and further education? Whose educational values can and should be represented in the model curriculum? What experiences will best prepare students to become high-quality, contributing members of the information assurance workforce?

Virtual lab facilities. Virtual lab facilities are maintained by CyberWatch as a cost-sharing model to help member institutions provide students with resources to engage in practical application exercises to accompany their coursework. These lab facilities include the CyberWatch Virtual Lab, the Digital Forensics Lab, and the CyberWatch Underground Tunnel System.

Student competitions. Highly visible among CyberWatch's activities are the student competitions which it supports and facilitates in a variety of capacities. The CyberWatch Mid-Atlantic Collegiate Cyber Defense Competition (CCDC), hosted in cooperation with White Wolf Security (now iSIGHT Partners) and a number of CyberWatch partners, is an annual event which brings students from seven states (Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, and West Virginia), as well as Washington D.C, to one location to engage in a hands-on, capstone project experience. Teams of students must ensure their configuration of computers can provide specified services while protecting them from attacks from an external group of hackers. The first competition was held in 2006, with 5 schools participating. In 2011 the number of participating schools grew to 22. The winning team earns the opportunity to compete in a CCDC competition at the national level.

The annual CyberWatch Digital Forensics Challenge, also referred to as the DC3 Challenge, is based on standards for digital evidence processing, analysis, and diagnostics set forth by the Department of Defense Cyber Crime Center (DC3). Individuals, teams, or institutions around the world can apply to participate. Participants are provided with approximately 25 challenges ranging from basic forensics to advanced tool development, and are asked to submit their responses electronically by a specific deadline. The DC3 Challenge website (http://www.dc3.mil/challenge/2010/index.php) provided participant statistics only for

the 2010 competition year. In that year, a total of 1,010 teams registered for the challenge. Of those, 295 were academic teams, 169 of which were made up of undergraduate students (the focus of our research). Of those who registered for the challenge, 71 (7%) submitted responses, including 23 academic teams. Among the academic teams, 12 were made up of undergraduate students, 6 were graduate student teams, 3 were high school student teams, and 2 were faculty teams. Within the academic category, the first place prize was awarded to an undergraduate team from a bachelor's degree program in Computer and Network Security at Wilmington University (WU), which is a CyberWatch member institution.

Finally, the CyberWatch Security Awareness Contest is an annual event conducted in cooperation with EDUCAUSE in which participants are invited to submit videos (30-second public service announcements or short videos of 2 minutes or less to be used in training or instruction) or informational posters designed to "explain information security problems and specific actions college and university students can take to safeguard their computers, mobile devices, or personal information" (http://www.educause.edu/focus-areas-and-initiatives/policy-and-security/cybersecurity-initiative/community-engagement/information-security-awareness-). Topics for posters and videos include, but are not limited to, cloud security and sharing considerations, computer security, cybersafety, passwords security, physical security, privacy, safeguarding data and personal information, securing personal devices, security risks of peer-to-peer sharing, and wireless security. All winning entries are licensed by EDUCAUSE for use under the Creative Commons Attribution-Noncommercial-ShareAlike 3.0 Unported License, and may be used to in educational and public awareness campaigns.

Student Enrollment and Demographics

One CyberWatch administrator reflected on the large number of non-traditional students that enroll in the AAS degree programs in information assurance that are a part of CyberWatch member institutions. He expressed that:

> We see an amazing numbers of students in our classrooms who – they already have bachelor's degrees. They're in 4- year programs and they come to figure out how to actually do something. I hate to be crass about it. (BS, p. 7)

He stressed the value that students placed on applied education over their theoretical learning experience in past baccalaureate degree studies.

Another important student population that the information assurance associate's degree programs serve are community college students with many "false starts" (BS, p. 3). These students come to the community college with broad or unclear interests and try many degree fields before settling on information assurance, collecting a number of technical credits along the way. Or, these students may start in information assurance, but pick up "three of four extra subjects" (BS, p. 3) just to explore their interests. These students can end up carrying a large number of technical credits that do not have a place to transfer into bachelor's degree programs.

Contributions to Standards Development / Encouraging Adherence to Standards

CAE2Y. The leadership of the CyberWatch Center played an integral role in encouraging the National Security Agency and the Department of Homeland Security's establishment of the Center for Academic Excellence 2-Year (CAE2Y) designation. Originally, a Center of Academic Excellence in Information Assurance Education (CAE/IAE) designation was available, only awarded to nationally or regionally accredited four-year colleges and universities with degree programs in cybersecurity that met a pre-

determined set of criteria. In 2006, CyberWatch administrators went to the National Security Agency and the Department of Homeland Security with the backing of several community college leaders to advocate for the importance of having a version of this designation to essentially create a new space for community and technical colleges on the information assurance map. While it took several meetings over the course of several years to establish the new designation, the first CAE2Y designations were awarded in 2010 to nationally or regionally accredited community colleges or technical schools, as well as state, federally-endorsed training centers, that offered a program in information assurance or related area that meets a number of criteria (e.g., mapping to the Committee on National Security Systems Training Standard 4011 and at least one additional standard). The CAE2Y designation extended the types of institutions that could be recognized by the NSA and Department of Homeland Security as offering high-quality educational opportunities in the information assurance field.

CyberWatch strongly encourages its member institutions to seek the CAE2Y designation. One of the services provided to member institutions is assistance mapping courses to the CNSS 4011 and 4013 standards. Table 9 provides a list of all institutions that have received the CAE2Y designation since it became available in 2010. The institutions are listed by their consortium membership. These data seem to suggest that a relationship may exist between consortium membership and receiving the CAE2Y designation, particularly in the early years of the award's availability. Although it is possible to secure a CAE2Y designation independently as seen in the 2012 year data, the support of cyber consortium partnerships may in fact provide resources and supports that facilitate or accelerate the process.

CyberWatch administrators express that the next step in the process is to facilitate connections between institutions that hold the CAE2Y designation and those that hold the CAE/IAE designation. One administrator expressed:

> One of the requirements ought to be that any student who graduates with a 2-year degree from a CAE2Y should have a smooth sailing into a CAE program, 4-year. Right? Why are they putting impediments in place? (VZ, p. 3)

This, however, appears to be a larger challenge of articulation and transfer among institutions, which is discussed in a later section.

Table 9. CAE2Y Designated Institutions by Consortium Membership and Year of Award

Year	CyberWatch Member	CSSIA Member	CSEC Member	Independent	Total
2010	• Anne Arundel Community College • Hagerstown Community College • Prince George's Community College	• Moraine Valley Community College	• Oklahoma City Community College • Rose State College		6
2011	• College of Southern Maryland • Community College of Baltimore County • Erie Community College • Inver Hills Community College • Richland Community College • Whatcom Community College	• Owens Community College			7
2012	• Harford Community College • Ivy Tech Community College • Montgomery Community College • Valencia Community College			• Bossier Parish Community College • Frances Tuttle Technology Center • Jackson State Community College • Minneapolis Community and Technical College • Oklahoma Department of Career and Technology • Sinclair Community College • Snead Sate Community College	11
Total	**13**	**2**	**2**	**7**	**24**

National Initiative for Cybersecurity Education (NICE). The National Initiative for Cybersecurity Education (NICE) is a nationally coordinated effort, led by the National Institute of Standards in Technology (NIST) and including more than 20 federal departments and agencies, for the purpose of enhancing security awareness, education, training, and professional development. The NICE initiative was founded as the result of two recent Executive Branch initiatives, carried out in 2008 and 2010 (http://csrc.nist.gov/nice/aboutUs.htm, January 29, 2013; Cybersecurity Workforce Framework, Sept. 2011). CyberWatch has embraced a role as a "major player" (COB, p. 5), specifically in the efforts related to formal education. In particular, there has been considerable discussion related to performance-based assessments and professional certifications. One CyberWatch administrator reflected that he is "hoping that these efforts push will put the community colleges on the map. It'll allow community colleges to position themselves to help start solving some of these workforce shortage problems" (COB, p. 5). He is hopeful that this will create such an opportunity because community colleges have a strong history of focusing on skills acquisition – "when people are talking about performance-based assessments and skills acquisition, that's the community colleges' bread and butter" (COB, p. 7). The applied nature of community college programs, and perhaps of applied baccalaureate degree programs, makes them a "natural fit" (COB, p. 5) for this type of approach.

Industry certifications. In addition to meeting the criteria for the CNSS 4011 and 4013 standards, the CyberWatch model curriculum emphasizes skills that help students prepare for a number of industry certifications, including CompTIA's Network and Security +, Cisco Certified Network Associate (CCNA), Microsoft Certified Professional (MCP), and Security Certified Network Professional (SCNP; http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=57&Itemid=64). While no claims or data are provided regarding students' pass rates on these exams after completing the CyberWatch model curriculum, the learning outcomes and objectives set for the curricula aim to prepare students to be successful on these certification exams.

Collaborations, Professional Development, and Community Outreach

CyberWatch K12 division. The CyberWatch K12 Division brings knowledge of cyberawareness and careers in cybersecurity to the K12 community (http://www.edtechpolicy.org/cyberk12/history.html). These efforts are led by Educational Technology Policy, Research and Outreach (ETPRO), a research and development organization located in Maryland that was founded in 2007 "as an entrepreneurial entity committed to quality education for all learners, targeting the effective use of cutting edge technology in formal and informal educational settings to increase interest in Science, Technology, Engineering and Mathematics (STEM) fields." ETPRO originated from the Educational Technology Outreach division of the College of Education, at the University of Maryland. Initiatives offered by the CyberWatch K12 Division fall into four primary categories: C3 Awareness, Workforce Awareness, Educational Programs, and K12 IT Systems.

C3 Awareness refers to efforts to inform the educational community about cyberethical, cybersafety, and cybersecurity implications of technology use, as well as to illustrate how students, parents, and educators can apply these concepts in their own settings. Sample resources provided online include: (a) a C3 Framework for promoting responsible use of technology, (b) results of a national study of what schools are teaching students about cyber crime and cyber security, (c) self-assessment and gap analysis tools, and (d) links to professional development toolkits (http://www.edtechpolicy.org/cyberk12/c3awareness.html).

Workforce awareness refers to providing information about the cybersecurity and information fields, as well as available career options and pathways. Sample resources related to this initiative include: (a) information on the need for cybersecurity workers, (b) an annual "Cool Careers in CyberSecurity for Girls" workshop, (c) an annual "Careers in CyberSecurity Workshop for School Counselors," (d) a Mid-Atlantic CCDC High School Shadowing, Career Fair and Expo, and (e) a number of cybersecurity-related competitions (e.g., DC3 Digital Forensics Challenge, US Cyber Challenge, CyberPatriot; http://www.edtechpolicy.org/cyberk12/c3workforce.html).

Educational programs are available in a wide variety of formats (before, after and during school; summer programs; cyber camps) for grade bands 3-5, 6-8 and 9-12. A common objectives across all curricula are developing digital literacy, preparing students to succeed in college, and developing skills needed in a 21st century workplace. Depending on the selected program, students also learn about topics such as programming/computational logic, coding-decoding/cryptography, system vulnerabilities, digital forensics and careers in information assurance/cybersecurity, as well as more about the security clearance processes and identity management strategies (http://www.edtechpolicy.org/cyberk12/programs.html).

Finally, the CyberWatch K12 Division offers training and workshop opportunities to administrators of local education agency technology systems in order to "help protect the vital information of students, educators, and administrators" (http://www.edtechpolicy.org/cyberk12/c3K12.html). The topics of these workshops are selected based on an annual needs assessment survey.

One CyberWatch administrator reflected that "our K-12 initiatives are really hot right now" (COB, p. 6). There appears to be strong interest on the part of industry partners for reaching into the high schools to recruit new talent by seeking out kids who are "in cyber clubs; they're doing this stuff on the weekends; they're demonstrating a commitment to a field above and beyond just traditional classroom learning." (COB, p. 6). This administrator finds this industry trend intriguing, and yet puzzling. He reflects that:

> This is probably an oversimplification, but to some degree it's like private industry has kind of given up on recruiting from the 4-year schools. … but private industry … kind of skipped over the community college piece … [and] is really kind of latched onto the K-12 thing for some reason. (COB, p. 6)

Faculty and Professional Development

Training courses, workshops, and seminars are offered to faculty at CyberWatch member institutions throughout the year on topics such as Ethical Hacking, Secure Programming, Digital Forensics, and a Certified Information Systems Security Professional (CISSP) Exam Preparation Course. The frequency with which these course opportunities are offered is unclear from our website research. Our most recent visit to the faculty professional development webpage occurred in January 2013 (http://www.cyberwatchcenter.org/index.php?option=com_content&view=article&id=102&Itemid=58). At this time, only two events were listed: (a) an eight week CISSP Preparation Course which began on May 7, 2012, and (b) a Certified Ethical Hacker (CEH) Preparation Workshop that was scheduled from June 18– June 22, 2012. There were no upcoming events listed.

This website also noted that the Faculty Graduate Program, which provided a resource for faculty members at CyberWatch member institutions to pursue funding to further their graduate studies, was no longer being supported.

Challenges and Areas of Concern

Articulation and Transfer. One challenge that CyberWatch has encountered to its work over the years relates to articulation and the transfer of courses between 2-year and 4-year higher education institutions. CyberWatch administrators report that "there is a great deal of reluctance on the part of universities" to accept an associate degree in cybersecurity "in totality" (VZ, p. 3). The barriers to transfer are thought to stem from two primary sources – disconnects regarding the number and type of required math and science courses and lack of standardization in curriculum from a state, regional, or national perspective.

Courses that make up the general education core (e.g., the number of English, humanities, and math credits required) are typically set by state law and embedded into institutional degree programs. CyberWatch administrators report that, in general, they have experienced little difficulty with meeting the requirements for English and humanities when it comes to transfer, even within their AAS degree curricula. However, stumbling blocks do arise in regards to general education when it comes to math and science classes. As described by one administrator, "in an AAS degree, you can get away with college algebra or some lower level math and maybe a non-lab science, and you cannot do that in an AS degree" (VZ, p. 3). Four-year degree programs are less apt to accept the lower level math courses or non-lab science courses to fulfill their lower level credit requirements, leaving a gap between in students' preparation for pursuing the bachelor's degree.

In regards to gaps in standardization, CyberWatch administrators discussed the number of technical credits that AAS degree students earn in their first two academic years of coursework, saying that:

> Oftentimes universities teach the same darn technical courses in junior and senior years. Because they take care of math and all the basic sciences, basic gen ed and all that in the first 2 years. So when we send our students, they say, well, this course you have to repeat, or it's not going to be accepted, or something along those lines. (VZ, p. 3)

As a result, the community college students' experience is disjointed as they attempt to make the connection along the 2-year to 4-year degree program pathway. Finding ways to create smoother pathways for students and to bring about standardization in the field of cybersecurity is particularly challenging due to the novelty of the field. One CyberWatch administrator highlighted this challenge by juxtaposing the field of Cybersecurity against the field of Chemistry, saying:

> Chemistry has been here forever, and so, it's very standardized. Everybody knows what you need to have in chemistry. If you're going to be a chemist, in the first two years this is what you take. Nobody thinks about it. I take chemistry two semesters, math to Calculus II or III, and so on. It's very simple. But not in the cybersecurity, which is an emerging, new field. It's very amorphous. (VZ, p. 4)

There has not been time for higher education institutions or the cybersecurity industry to develop or agree upon a standard curriculum for this field. Furthermore, the majority of four-year colleges and universities do not offer bachelor's degree programs in applied technology fields. Their technology-related degrees are in engineering and computer science curricula. Even when a cybersecurity focus is available at a four-year institution, it is offered within a "computer science [program] to which they added some security. That's it." (VZ, p. 4). As a result, there are few bachelor's degree programs available that align well with the AS or AAS model degree programs that CyberWatch promotes. The recent partnership established with WU is held up as a model articulation agreement that is "unusually positive for 2-year institutions" (VZ, p. 7). This baccalaureate degree pathway was made possible because of the personal networks between CyberWatch and the WU program director who is "so familiar with the [CyberWatch] program… [and] knows exactly what these students are getting" (VZ, p. 7). Continued efforts are underway to create standardized, state-wide articulations among 2- and 4-year higher education institutions and degree programs, but all involved recognize that this is a multi-year effort. Cybersecurity is a young field, and it will take time and effort to develop these broad articulations.

Options for baccalaureate degree pathways. Students transitioning from an associate degree in information assurance may be interested in a variety of baccalaureate degree pathways, which result in specialization areas such as:

- Advanced technical skills
- Technical management – developing human resources, management, and supervisory skills
- Policy – Developing usage policies for computer networks and incident response teams

When considering the development of baccalaureate degree pathways, CyberWatch administrators believe that it is important to develop articulations with colleges and universities that offer programs that can prepare students for future careers in along these various paths.

Novelty of the cybersecurity field – few resources to point to demonstrate demand. One of the challenges that CyberWatch consortium schools had experienced in the past was a lack of resources to clearly define and demonstrate the need for cybersecurity professionals. This makes it difficult to advocate for the development of cybersecurity degree programs. For example, during the time of our site visits in March 2012, CyberWatch administrators shared that the Occupational Outlook Handbook had data regarding the field of Information Technology, but "there [were] no job roles for cybersecurity" (COB, pp. 4-5). Anecdotal evidence was available regarding an "inverted supply and demand, where there's a huge demand for qualified cyber security professionals" (COB, p. 5), yet without strong sources, this information was not enough to make compelling arguments for program development.

The development of a Cybersecurity Workforce Framework (http://csrc.nist.gov/nice/framework/) as a part of the National Initiative for Cybersecurity Education (NICE) led by the National Institute of Standards in Technology (NIST), was a first step aimed at addressing this informational gap. The framework organizes the field of cybersecurity into seven high-level categories, each comprised of specialty areas. Definitions of each work area are provided, along with sample job titles, tasks, and requirements for knowledge, skills, and abilities that one must be able to demonstrate to be successful in that position. This framework provides a foundation for the field to "start doing job projections based on those roles" (COB, p. 5) so that educational programs may be developed to address economic needs.

Curriculum revision. Another challenge for the CyberWatch organization is keeping the model curriculum up-to-date. As expressed by one CyberWatch administrator: "the faculty and others are saying we need to revise the curriculum; it's getting stale" (VZ, p. 7). They also reflect that NSF-ATE Centers serve an "amazingly important role in helping curricula be up-to-date" (VZ, p. 8), particularly in new and emerging fields, because of the opportunity for faculty to collaborate and to learn from each other's varying areas of expertise.

Industry partnership as an area for growth. CyberWatch is also playing a role in attempting to spur a cultural shift in the way that the cybersecurity industry views the associate degree and the preparation of associate degree students for the workforce. Historically, in the Maryland-Delaware-Washington, DC region, a bachelor's degree has been the key to entry level jobs in the cybersecurity field – "not because you need to know that much, but because the piece of paper is there" (BS, p. 5). CyberWatch administrators suggest that this tradition may be related to job requirements that are historically written into government GS pay scales, as well as the high volume of contract work in the area. Many contractors work to fulfill positions similar to government positions, and therefore "very often just copy the job requirements for the federal job" (BS, p. 5). Additionally, contractors can bill at a higher rate for employees with a bachelor's degree, as compared to employees with an associate degree. These are difficult forces and traditions to change.

However, as noted across the institutions in this case, the bachelor's degree requirement is starting to loosen as the demand for skilled workers outpaces the supply of bachelor's degree recipients. On the one hand, there is a sense that "the guys who get a bachelor's degree in traditional computer science and computer engineering, they don't want to spend their lives doing the kinds of things that [information assurance associate degree graduates] know how to do" (BS, p 5). There is, perhaps, a fundamentally different skill and interest set developed in the different academic pathways that can make associate degree graduates attractive to employers.

Another challenge that employers face is the need for individuals who have or who can obtain a security clearance. As bachelor's degree enrollments decline, or as the number of international students in bachelor's degree programs rise (who have difficulty obtaining a security clearance), employers must look toward other avenues for sources of new talent.

One CyberWatch administrator reflected, employers had "come to value the CAE status" (VZ, p. 6) which had been solely associated with the 4-year institutions in the past. But, CyberWatch administrators view their work as slowly finding ways to change an employment culture. They established a CAE2Y designation, and developed standards and a model curriculum. These are examples of efforts that help them "keep fighting and trying to show the industry and demonstrate this is what the [associate degree graduates and] students have; these are the skills they've gained. This is the knowledge they have or potentially have" (VZ, p. 6). These efforts are made with the hope of creating new opportunities for students who pursue associate degrees in this applied information technology field. And, CyberWatch administrators reported that "slowly, slowly, we are making headway" (BS, p. 6) For example:

Some of the federal agencies are beginning to say, "Well, if you've completed a AAS degree and you're enrolled to a 4-year program – we'll take you as an intern." "We'll take you as a summer program." … And we are successful at placing our students in non-government related, non-defense industry private jobs. Go to work for Bank of America. Go to work for Giant food company. Go to work for the hospital who has to protect medical records. We're pretty good at placing those kind of guys. (BS, p. 6)

Making greater progress in asserting the value of the associate degree is expected to be one of the initiatives that CyberWatch engages as it expands its role to become a National NSF-ATE Center. CyberWatch administrators discussed the importance of embracing a national leadership role in a "communications campaign, where we really start trying to educate procurement folks and HR people" (COB, p. 8). Ultimately, the goal will be to chip away at negative images in corporate and popular culture that community colleges struggle with, such as:

- "Low cost in community college education equals low quality" (COB, p. 8), and
- "A lack of understanding of the community colleges in general - That's where the dumb kids go." (COB, p. 8)

These messages would be replaced with demonstrations of the successes of community colleges: "Look what we do. Look what our strengths are. Look what we've done for 50-some years, and look what we've done in cyber for the past decade." (COB, p. 8-9). CyberWatch administrators reflected that making a broad national impact in the field of cybersecurity and "solving some of our nation's problems" (COB, p. 9) would be greatly facilitated by dedicating time and resources to also changing perceptions about the community and technical colleges that make up a significant portion of the core membership of the CyberWatch consortium.

Sharing What Works: Evidence of Effectiveness and Success

Challenges to gathering evidence of success. Clear evidence regarding how many students take advantage of the articulation agreements that exist is difficult to obtain. CyberWatch administrators state that they "really play up the articulations" when talking with students, but that there are "problems inherent with students leaving our institution and having a hard time tracing them" (COB, p. 11). The only evidence that could be offered at the time of our site visit in March 2012 was anecdotal, suggesting that small numbers of students had "gone through these articulation agreements… maybe a couple of students a year" (COB, p. 11).

Anecdotal information on careers and employment. The information that CyberWatch administrators shared in relation to student employment outcomes following participation in degree programs at CyberWatch member institutions was anecdotal. However, the anecdotal statements and messages that were shared were stated in strong and certain terms. For example, one CyberWatch administrator stated:

> You get a degree in this field, there's a zero percent unemployment rate. Zero. I guarantee it. In fact, if you can't find a job, come here and we'll hire you here at this school. … There is nobody without a job who has these skills (BS, p. 8).

CyberWatch administrators expressed confidence that the experiences that students received in the classroom provided strong cues regarding preparation for the world-of-work. One CyberWatch administrator expressed that: "The stuff that you learn in school is the stuff that you actually do on the job. And so, if you find that you enjoy it in school, then maybe you'll enjoy it on the job" (BS, p. 9). As such, students who successfully completed and were satisfied with their coursework, were expected to also find job satisfaction.

Views on AB Degree Pathways. Contributing to the development of baccalaureate degree pathways was not a central part of the original CyberWatch scope of work, but it is "something that evolved" (VZ, p. 12) into their areas of interest as a "natural extension of [their] programs" (COB, p. 2). Issues related to these degree pathways have become particular poignant over the years as they observed students' encountering challenges with articulation and experienced some regional articulation successes with institutions such as WU. There is some discussion about "putting that as one of the issues on the table… looking at building an applied baccalaureate" (VZ, p. 12) as CyberWatch takes on its new role as an NSF-ATE Center.

After considering the challenges in articulation and transfer, our site visit team invited CyberWatch administrators to share their thoughts on the development of applied baccalaureate degree pathways. General consensus began with the reflection of a great need for students from applied associate degrees to have opportunities to continue onto a bachelor's degree without losing a significant number of credit hours during the transfer process. For example, one CyberWatch administrator shared that:

> I would love to see more applied baccalaureates. There's such a need. … Because you need to make and provide the pathway for the students with the AAS degree to be able to go on and to be able to get the baccalaureate degree without having to do somersaults. … It doesn't make sense in this economy and today's world not to do more of that. (VZ, p. 8)

Another administrator stated that applied baccalaureate degree programs are of central interest to CyberWatch because they are "a natural extension of our programs, and we want to encourage more 4-year schools to think about these applied baccalaureate programs" (COB, p. 2).

However, these administrators also shared a sense of skepticism regarding the types of 4-year institutions that would be willing to get involved in the development of AB degree pathways, as well as the incentives for doing so.

> Unfortunately our universities are pretty set in their ways. And there is not much impetus and no incentive for faculty to do it. Why would they stick their neck out when they need promotions? … The Chairs are concerned how many research projects I have, and so forth and so on. Why would I go into this, which is messy, which is going to pin me against some other departments? There are lots of intra-institutional issues which prevent this. (VZ, p. 8)

Rather than targeting all institutions for the development of applied baccalaureate degree pathways, CyberWatch administrators discussed the importance of considering which institutions have "a culture of interest in that, and they see the value" (VZ, p. 9), and building collaborations upon those common interests.

The early baccalaureate degree-granting institutions that CyberWatch has focused on for developing consortium-wide agreements are those that CyberWatch administrators perceived were "ripe for this kind of articulation agreement" (COB, p. 3). They first looked toward UMUC, because it is a primarily transfer and commuter institution that they expected would understand the needs of students who were graduating with an applied associate degree in the cybersecurity field. CyberWatch administrators then looked toward Capitol College, pointing to the history of the institution, and stating that although their programs "don't have the various kinds of applied baccalaureate designations, they really were applied B.S. programs. Students from our CyberWatch 2-year schools could easily transfer into those programs and continue the real applied nature of what they had started at the 2-year level" (COB, p. 1). An agreement with WU then grew out of networking connections that provided an "incredible deal" (COB, p. 1) of a maximum of 75 associate degree credits transferring to the baccalaureate degree-granting institution, facilitated by the flexibility of Wilmington University's status as a private institution and the differing laws regarding transfer of credit in the State of Delaware (as opposed to the State of Maryland).

Prince George's Community College's Associate of Applied Science (AAS) in Information Security

Founded in 1958, Prince George's Community College (PGCC) is located in the Washington, DC area, with its main campus in Largo, Maryland and additional sites in Hyattsville and Laurel. It offers 60 programs of study to over 14,000 students. PGCC has a reputation for serving a diverse student population. According to their website (http://www.pgcc.edu/About_PGCC/About_PGCC.aspx), in the 2012-13 academic year, over 20,000 students were enrolled in credit-bearing courses across their multi-campus system, representing more than 100 countries throughout the world. PGCC serves "more African-American students than any other postsecondary institution the state of Maryland" (http://www.pgcc.edu/About_PGCC/History.aspx), with 76% of their student body identifying as Black/African-American (6% of students identify at Hispanic/Latino, 5% as White, 3% as Asian, according to 2012-2013 IPEDS data). The institution offers more than 200 academic programs and workforce development and continuing education courses, with a mission to "provide a gateway to a highly relevant, meaningful, accessible, affordable, and quality education, through a learning-centered environment that engages students academically and socially."

Institutional View of Applied Education and Degree Pathways

One administrator at PGCC expressed her views about the importance of providing all community college students - including those who begin in Career and Technical Education (CTE) programs - access to bachelor's degrees via clearly identified pathways. She expressed that:

> We would like to make sure that when students finish up here [PGCC] and elect to go someplace else that their credits are easily transferrable. The process [should be] transparent, known in advance, and with some planning, students will be able to identify courses that they should take in preparation for not only completing their degree here, but also for transferring to the receiving institution. (CLP & MG, p. 2)

She described the development of AB degree pathways is a natural progression, drawing a parallel to the development of the Bachelor of Arts in Business Management: "Do you remember when that was considered – a four-year degree in business? How atheoretical is that? And now, it is accepted." (CLP & MG, p. 1). Specifically designing an applied baccalaureate degree pathway in information security, was viewed as making "perfect sense" (CLP & MG, p. 1) with a curriculum which encourages students to "exercise intellectual curiosity" (CLP & MG, p. 4), strong industry demand both locally and globally, and availability of well-paying jobs.

The AAS in Information Security Degree

The Associate in Applied Science (AAS) in Information Security degree program is offered through the Department of Information and Engineering Technology in the Division of Science, Technology, Engineering, and Mathematics. The department has 17 full-time and 47 part-time faculty.

Developing the degree program in the division of STEM. Program administrators acknowledge that, since the Information Security degree program was developed approximately five years prior to our visit (2007), technology and the field of cybersecurity continues to evolve, which demands changes to the curriculum. Some curriculum changes are straight-forward. For example, the Security+ coursework is on its third renovation in just five years. As described by the faculty member who teaches the courses:

> As the author comes out with a new book, I make sure we get it in right away. Because you want to keep current to the curriculum that's being used toward those industry standard exams. You don't want to be teaching those students an exam that's missing information or changed information. (MB, p. 12)

Because these changes are driven by clearly defined industry certification requirements, they are quickly translated into course materials and communicated to students.

However, in situations where industry standards, requirements, and needs are less clear, PGCC faculty and program administrators have been slower to make curriculum modifications. For example, during the time of our site visits, a National Initiative for Cybersecurity Education (NICE) was underway, led by the National Institute of Standards and Technology to create "a working taxonomy and common lexicon that can be overlaid onto any organization's structure" (NICE, 2011, p. 1). Furthermore a taskforce made up of members from the 16 community colleges across the State of Maryland was in the process of meeting to determine, based on industry standards, what technical capabilities were necessary for the jobs that were currently available in cybersecurity so that they could "make sure [the skills] are in our curriculum" (MB, p. 17). Until these two tasks are complete, PGCC faculty and program administrators suggested that it seemed premature to revise their curriculum – "it's hard for us to map our curriculum to something that's not finished yet. It's kind of like a cart and horse type of thing" (MB, p. 12).

One faculty member reported that progress continued to be made on this task when we spoke again in July 2013. Work was being done on a version 2.0 of the NIST NICE standards, with "hopes to be done by August 2013," at which point the CyberWatch AAS model curriculum could be structured to fit the new requirements. There was also discussion of developing a new AS degree that could map better to the four-year degree programs available in Maryland.

There has also been some discussion of expanding the AAS curriculum to add new specialty areas, perhaps in areas such as secure programming, quality assurance, and security operations. This way community colleges would not have to specialize in the same programmatic area. One faculty member asserted that, "Maryland is the leader in cybersecurity education. This is substantiated by Maryland having the most CAEs and CAE2Ys in the country." He stressed that this is a good platform from which to push an educational agenda – building the platform in Maryland, and then moving it forward to other areas of the country.

In summary, the PGCC faculty member stresses that, while their curriculum may be a bit dated in some areas, it is "not static." For example, they are on their fourth rendition of the Security+ curriculum. Additionally, they were awarded a BRAC supplement grant to put their certificate courses into an online format and, during that transition, they updated the course content. While the concerns about "putting the horse before the cart" with updating curriculum before evolving standards have been completed has slowed curriculum development, the faculty stress that they believe they have played an active role in helping bring

the disjointed pieces together by engaging these conversations in the field. Therefore, they have positioned their institution well to be a leader in developing and shaping the next cybersecurity curriculum directions.

Program learning goals and objectives. According to the degree program website (http://academic.pgcc.edu/iet/Degrees.htm#540), AAS degree graduates will be able to:

- Plan and implement network router and switch configurations
- Monitor the security infrastructure to include analyzing network problems and traffic flow
- Identify and remove network security vulnerabilities and threats
- Create and enforce an organizational security policy including contingency plans
- Install, configure and manage Windows and UNIX/LINUX network operating systems
- Install, configure and monitor a firewall
- Use the curriculum fundamentals to prepare for the A+, CCNA, Network+, Security +, CISSP [including Associate of (ISC)2], and SCNP industry standard certifications

Curriculum design. The AAS in Information Security requires 62 – 64 credit hours of course work. Degree requirements are divided into three areas: general education, program concentration, and electives. To begin taking college-level courses as a part of this degree program, students must demonstrate reading and writing proficiency, as well as "a solid foundation in mathematics," via a placement exam or by exemption as a result of prior coursework. General education requirements include two courses in English composition, one humanities course, finite mathematics (or higher), one science course, one social science course, and introduction to information technology (unless exempted through exam or proof of proficiency). Under the category of "general electives," students are required to complete 3 credit hours from any subject.

Within the program concentration, students take approximately 11 courses that examine issues of information security awareness, network security hardware, systems and network security planning and defense, network security organization, and legal and ethical issues associated with information systems security. The completion of a capstone project is required of all students, and internship experiences are strongly encouraged. Courses in this degree program also address the fundamental skills and knowledge needed to prepare for the A+, CCNA, Network+, Security+, and SCNP industry certification exams.

The AAS degree program "provides the skills for students to become highly skilled computer security professionals and to train individuals for entry-level positions as data security analyst, systems security administrators and network security administrators" (http://www.pgcc.edu/Programs_and_Courses/Program_Detail.aspx?programID=6442462380).

A potential challenge on the horizon was from a recent law passed by the Maryland state legislature that restricts the number of credits for associate degree programs to 60. Some exceptions may be requested and granted. However, one faculty member that we spoke to expressed that it would be challenging to further cut back the degree program to 60 credit hours. Some courses had already been trimmed from 4-credit-hour to 3-credit-hour, and there were concerns about making further cuts. If credit hours had to be limited, a preference was expressed for including more writing and communication skills into technology based courses, rather than requiring students to take more general education courses outside of the technical courses. A tension was expressed between offering a well-rounded education, and offering the depth desired in the field that the degree program was design to prepare students.

Several related certificates programs are also offered. The Information Security certificate, consisting of 6 courses (18-19 credits), provides students with the foundation needed to pursue CompTIA's Security+

certification. The Information Security Management certificate addresses the needs of technical and security staff for both managing and implementing information security projects. Coursework includes basic computer operations, operation systems, security, cyber law, disaster recovery, project management, and systems analysis. This certificate consists of 5 courses (16 credits). Courses take in both of these certificates may be applied to the AAS degree program in Information Security. The Engineering Technology department offers a Cisco CCNA Preparation certificate that also relates well to the AAS in Information Security degree. Certificate programs typically contain technical courses in the selected field of study, without including the general education courses required for an AAS degree. Finally, a certificate in Cybercrime Investigation is also offered, focusing on the investigation and prosecution of cybercrime once it has occurred. The courses in this certificate program can be used toward the pursuit of an AAS degree in Criminal Justice, Cybercrime Investigation Option.

Articulation agreements to bachelor's degree programs. Articulation agreements exist between PGCC's AAS degree program in Information Security and Capitol College's BS in Information Assurance degree (signed in 2008, may transfer a maximum of 70 credit hours), Towson University's Bachelor of Technical and Professional Studies (BTPS) in Information Technology (signed in 2008, may transfer a maximum of 64 credit hours), and University of Baltimore's Bachelor of Science (BS) in Applied Information Technology (signed in 2008, may transfer a maximum of 60-credit hours). A joint agreement also exists with UMUC, signed in 2003) for transfer to a variety of degree programs. Of the available programs at UMUC, perhaps the most directly related to PGCC's Information Security AAS degree is the BS in Cybersecurity which offers a policy and management focus. In 2011, PGCC entered into an articulation agreement with WU's BS degree program in Computer and Network Security. The agreement with WU was touted by CyberWatch administrators as an "exceedingly applied degree … [that] is to be applauded and encouraged" (BS, email communication, 10/12/11). Characteristics of this articulation that stand out include that PGCC students can transfer up to 75 credit hours to Wilmington University, leaving only 45 credits to be taken at WU for graduation. Additionally, if students have taken a lower division community college course that is comparable to an upper division course at WU, the course does not have to be retaken. Rather, the student may substitute a different upper level course for the needed credit hours. However, likely due to the novelty of the agreement at the time of our March 2012 site visit, as well as perhaps to other factors (e.g., the distance between the PGCC and WU campuses and the small number of PGCC graduates), no students had yet transferred from PGCC to WU under this articulation agreement. In July 2013, the articulation with WU was reiterated as a model – the articulation to design others after.

AAS degree-seeking students who are interested in transferring to a bachelor's degree program are encouraged to "work closely with the Information and Engineering Technology department chair and Advising in order to meet the requirements of the transfer institution." (http://www.pgcc.edu/Programs_and_Courses/Program_Detail.aspx?programID=6442462380).

Student reflections on transfer and articulation. During our March 2012 visit, we held a focus group with 7 current students in the AAS degree program in Information Security. Of those 7 students, 4 stated that they intended to transfer to a bachelor's degree program following their graduation from PGCC. (The remaining 3 students intended to seek employment.) Two students were planning to transfer to Towson University because past teachers had stated that Towson "had a good program" (Student focus group, Participant 3, p. 2). Information regarding what made Towson's program high quality, however, were unclear.

> Participant 3: I thought I'd transfer to Towson because they have a good technology degree over there. Plus I heard that an information security degree isn't very common at a lot of universities. Towson has a good program, yeah. My teacher says that he considers it better than [University of] Maryland.

Researcher: Better in what way?

Participant 3: I don't know. He didn't tell me. He just said he considers Towson better than [University of] Maryland. (Student focus group, p. 2)

The other two students planned to transfer to UMUC, with convenience and affordability listed as primary draws.

Students who intended to transfer were relying heavily on information posted to institutional websites for their planning and preparation. One student mentioned the possibility of calling the department that he intended to transfer to gather more personalized information, but then mentioned that he had not taken that step personally. Students expressed that they feel they have the information needed to make smooth transfer experiences happen, based on gathering much of their information through independent web searches and self-advising based on their own perceived needs. For example, one student expressed that:

Participant 6: I've been to UMUC's website and I… actually have 62 credits, so I'm like, sitting here. I've just been taking up classes. It's cheaper for me to take the lower classes that I need here and transfer them to UMUC, so that's what I've been doing. (Student focus group, p. 8)

This is a point of potential concern, particularly in relation to (a) concerns heard from faculty and academic advisors regarding challenges encountered when students self-advise and find themselves with credits that will not transfer or courses that are taken out of sequence, and (b) challenges students may encounter with transfer when too many credits are taken at a lower division institution. For example, according to the Maryland Code of Regulations (13B.02.02.15), when transferring credits, the receiving institution is required to limit the credits earned in or transferred from an associate degree-granting institution to approximately half the baccalaureate degree program requirement, not to exceed 70 credits, as well as to limit these transfer credits to the first 2 years of the undergraduate educational experience. A student who has already completed 62 hours, and is continuing to take credits at a community college for the purpose of saving on tuition, may actually be raising their total tuition dollars spent in the long run.

Enrollment and Student Demographics

Accurate program enrollment numbers are challenging to report because students are not required to declare a major in order to enroll in classes. In the spring of 2012, program faculty reported that approximately 40 students were declared in the AAS degree program in Information Security (MB, p. 14). (Campus administrators reported that degree program enrollment was 68 in 2011. [CLP & MG, p. 3]) The program is still "relatively new, starting just 5 years ago" and declared enrollment has increased approximately 40% each year (MB, p. 14). Additional efforts are underway to build infrastructure and secure funding to continue to grow the program enrollment (CLP & MG, p. 4). Despite the small numbers of declared enrolled students, unduplicated headcounts of students enrolled across all Information Security classes in Spring 2012 were quite a bit higher, at 482 students. This includes students with undeclared majors and those who are taking information security courses as electives to be applied to different degree programs at PGCC. In July 2013, the unique headcount had continued to climb, now over 500, but a faculty member reported that it is still "a nightmare to do valid statistical counting... students don't declare, [and those who have the classes to graduate] fly out the door without a degree." There is some push on campus from faculty and from some at the Vice President levels to eliminate the $50 fee for graduation. There is a very strong push on campus for completion that comes from the President, and the graduation fee for both certificates and associate degrees is viewed as a barrier. This is particularly the case for students in technical courses who may have a primary goal of taking courses toward a certification exam. They may be focused on the exam, and care little for the certificate or associate degree, particularly if the student comes in with a bachelor's or master's degree

already. The student's choice to not pay a graduate fee in these cases only hurts the institution in the long run. If the institution drops the graduation fee and can start counting these students as certificate and degree completers based on course completion, the institution's performance reports could improve considerably.

In terms of student descriptions, program administrators report that there is no "typical" student. Students range in age "from 16, still in high school, all the way up to… 60s, 70s at least" (MB, p. 6). Some students are employed, while others are unemployed and looking for a career change. Several students already have a bachelor's or master's degree, yet take courses at PGCC in order to earn a certificate or to prepare for a Security+ or CCNA exam.

Interestingly, in terms of enrollment in classes the balance between males and females is "almost 50/50," although slightly biased towards males. This ratio is "slightly higher than the state averages" (CLP & MG, p. 3). However, the majority of students who get involved in the cybersecurity competitions are males. As expressed by one faculty member, there is a perception that the few women who do get involved are "very headstrong," and a "theory" exists that perhaps women generally "do not like the competition environment" (MB, p. 18). This is a point of concern for some faculty because the competitions provide unique opportunities for students to learn and to demonstrate their skills. As expressed by one faculty member, "these students get excited about the cyber competitions. It seems to get a magical – it doesn't take a lot to get them fired up. They love that hacking and protecting, and the challenge of it" (MB, p. 7).

When talking with current Information Security AAS degree students in a focus group, we found that most students learned about the degree program through personal connections with friends, family, a teacher or a professor. For example, one student was encouraged by a professor to consider cybersecurity after taking a single related class – "She was telling me that after 9-11 they realized that they needed more people who could provide security, cyber-wise. And they paid good money. Also, this is not like the programmer or computer engineer, or that kind of thing. This is more accustomed to me" (Student focus group, Participant 3, p. 1). Another student (Participant 2) received encouragement from his parents to pursue the AAS in Information Security because they saw the degree as leading to well-paying jobs in a high-demand field.

Faculty Roles and Positions

There are approximately 4 or 5 full time faculty members who teach in the Information Security degree program, with a "pretty large cadre of adjuncts" (MB, p. 13). Several of the adjunct faculty members have taken advantage of reimbursement funds available through the CyberWatch Center to pursue graduate coursework at Capitol College, with one receiving a graduate certificate in Cybersecurity and another receiving a master's degree in Cybersecurity. Three of the full-time faculty members at PGCC have Master's degrees in Information Assurance. One is working on a doctorate degree in Information Assurance. Reflecting on the credentials of this faculty group, a program administrator reflects that he believes that PGCC's Information Security program is "ahead of the norm" (MB, p. 13) compared to other community college programs.

Challenges and Areas of Concern

Creating pathways to bachelor's degrees. Working with regional and statewide organizations aimed at developing partnerships and transfer relationships across information technology assurance programs within and across Maryland colleges and universities, faculty at PGCC have encountered a number of challenges and concerns regarding student experiences with credit transfer. On the one hand, many students who take courses via Career and Technical Education (CTE) programs find that their credits do not transfer to degree

programs at four-year institutions. The community college curricula are "so strong on the technical aspects" of coursework, but are missing the "what do you think about the world type of thing, all the gen ed stuff" (MB, p. 2). It presents an intriguing challenge to 4-year institutions that traditionally reserve much of the technical application learning for the upper division coursework – "even the ones we have good articulations with, they're not sure what they should be doing those last two years" (MB, p. 4). The four-year institutions also communicate to the two-year institutions that they struggle with where the community college's technical courses fit within their requirements, as well as with the lack of general education courses, essentially saying: "it's not fair to [the students], because then when they come to us, they have to take another three and a half years to earn their degree" (MB, p. 2).

To address this challenge, efforts are underway to create state-wide articulation agreements for cybersecurity programs. The goal is to develop a "good product" that provides students opportunities in four "different tracks" based on their career interests (MB, p. 16). One track would be designed for students who desired to stay within the cybersecurity field, and "to keep technical and continue honing their technical capabilities or build new technical capabilities." The second track would be for those who would like "to continue on to be more of a manager." The third track would focus less on hands-on application of technology, with a focus on assessing needs and policy development. The articulation agreement with UMUC is an example of this third track, such that students receive technical coursework at PGCC, followed by upper division coursework that focuses on "policy creation, development, and implementation" (MB, p. 4) at UMUC. Each of these tracks represents an applied focus for the bachelor's degree. The fourth track would be to keep an open door for those students who would be interested in moving out of the cybersecurity field into the more theory-oriented, traditional computer engineering or computer science fields, such as the programs offered at University of Maryland-College Park. Note that it is programs such as those offered by University of Maryland-College Park that particularly struggle with the acceptance of the applied associate degree coursework as described in the previous paragraph. So, this challenge still remains in the new structure that is in development, however, the work of these taskforces is aimed at bringing about greater clarity on alternative pathways to the baccalaureate degree for students who hold an AAS degree in information security or cybersecurity related fields. In July 2013, one faculty member reported that in the last couple of meetings this task force has made particularly good progress. He attributes this progress to University of Maryland-College Park representatives "not showing up" to the meetings. College Park has shown the greatest resistance to the development of these degree pathways, and it is felt by some members of the taskforce that they have been creating barriers to moving the process forward.

Keeping up with advances in technology. A second challenge – similar to that experienced by other degree programs in this case – is keeping up with the rapid changes and developments in technology. However, program administrators in this case perhaps feel extra pressure to have well-designed laboratory spaces and up-to-date equipment as PGCC is highlighted as the home institution of CyberWatch and the lead for the State of Maryland – "the epicenter of cybersecurity," as expressed by U. S. Senator Mikulski in a press statement at PGCC on February 23, 2012. As one program administrator expressed, "I'm embarrassed… we need to have these tools" (MB, p. 15). In response to expressed needs, PGCC developed two new virtual labs in the Center for Health Studies, which opened in July 2012, shortly after our site visit (Press Release, July, 27, 2012). These labs provide students 24/7 access to equipment for practice and homework assignments, as well as the ability to create practice environments (e.g., a system for penetration testing) that students can keep and build upon throughout an entire semester.

Security clearances and international students. Security clearances for international students were also mentioned as a challenge. At PGCC, they see many international students who are interested in cybersecurity careers. However, many of the available jobs in the cybersecurity field require security clearances – "even industry wants people that they can do background checks on. It is very hard to do background checks on foreign students unless they have been in the country for a length of time. So, that's a problem" (MB, p. 18).

Students' balancing school, work, and family. Finally, PGCC caters to many non-traditional college students. As such, current Information Security AAS degree-seeking students who participated in our focus group expressed challenges balancing the multiple demands of school, work and family. In the students' own words:

> Participant 1: "We are all full-time workers, part-time students, fathers, mothers. We have a full life outside school." (Student focus group, p. 5).
>
> Participant 6: "My challenge is pretty much work and school. Full-time work and come to school, juggling home" (Student focus group, p. 5)

Sharing What Works: Program Quality

Adherence to recognized standards - Mapped to standards. The degree program meets the outcomes-based education standards set by the National Security Telecommunications and Information System Security Instruction (NSTISSI), and is mapped to standards 4011 (Information Systems Security Professionals) and 4013E (System Administrators). Program administrators reflect that, while most of these standards "are relevant – a firewall is a firewall; an intrusion detection system is an intrusion detection system" (MB, p. 12), it is import to recognize that these standards are "out of date" and are in the process of being updated.

Therefore, many CyberWatch-affiliated institutions, including PGCC, have "gone even a step further" (MB, p. 12) to become designated a National Center for Academic Excellence – 2 Year (CAE2Y) in Information Systems Security Education by the National Security Agency and the Department of Homeland Security. Becoming a CAE2Y institution requires looking beyond the curriculum, to how the entire College impacts program quality including partnerships with K-12 schools, articulation agreements with 4-year institutions, faculty credentials and education requirements, and so on. The PGCC university website notes this designation, as well as their role serving as the home institution for CyberWatch, as a highlighted "institutional success" on their central institution web pages (http://www.pgcc.edu/About_PGCC/Recognition_and_Awards.aspx).

Mapped to industry certifications. The focus on the role of industry and industry certification in curriculum design was more central at PGCC than in the conversation at other CyberWatch member institutions that we visited. As described by one Information Security program administrator, this connection to industry is a key feature that differentiates community college degree programs from traditional four-year baccalaureate degree programs. He stated that at "community colleges, we focus on industry standards, the technical capabilities that [students] need in the job that they are going for" (MB, p. 3). For this reason, the Information Security program is mapped to security certifications such as A+, Network+, Security+, CCNA, and so on – "So, [students] take four classes to get their CCNA. One class maps to the CompTIA Security+. A combination of engineering technology and [information security] classes map to the A+ and Network+." Each time the industry certification training materials or exams are changed, the PGCC courses are immediately updated (as previously discussed), so that the industry standards are, in a sense, driving the content of related courses. The students gain concrete, technical expertise through their coursework and – although they may need some time to get acclimated to a new environment or new piece of equipment – they are essentially ready to go on the job on the first day.

This is a slightly different way of discussing industry certifications than found in other cases or at other institutions. Other cases expressed that student's ability to pass industry certifications as evidence of the success of their program – an outcome measure. But, here, we see industry certification being discussed as an input to the program. It is articulated more clearly by the respondents in this case (as compared to other cases) as a program design component that serves as a way to ensure program quality (rather than as a way to

measure quality further down the line). The value of industry needs and input is elevated in this case – "we try to map to the industry certification because right now that seems to be what the industry wants" (MB, p. 7). There was little discussion about outcomes at PGCC – whether PGCC students pursued or passed industry certification exams after taking the courses that were designed to prepare them for exams. Only one current student talked about the exams during our focus group, stating that:

> Participant 1: I did not take any certification… because I didn't have the time, I didn't feel comfortable. There are many excuses that I can tell you. But probably now is the time for me to go back to the old books and study just to get the certification just to get me into the field. To put my foot into the [information technology] world. (Student focus group, p. 3)

This student recognizes the importance of following through with pursuing industry certifications, but chose not to do so, for a variety of reasons, while engaged in the PGCC classes.

As expressed by one faculty member, students follow-through on taking certification exams is essential to their employment outcomes following the program: "Students who take advantage of industry certification have an easier time getting a job. Those who don't get certifications are having trouble getting a job." Employers in the current market want experience. Certification exams are viewed as one way to demonstrate that.

Collaborations to strengthen quality and effectiveness.

NSF-ATE Centers. PGCC's AAS degree program in Information Security is closely affiliated with the NSF-ATE CyberWatch Center, which is physically located in the same building as the Information Security program department and in which the classes are taught on the PGCC Largo, MD campus. PGCC's application to become designated as a CAE2Y institution (written in October 2009) outlines the ways in which they have experienced their degree program benefiting from the relationship with CyberWatch, including:

- Collaborations with consortium partners to share best practices, methodologies, curricula, and course materials and modules;
- Faculty Information Assurance (IA) training through CyberWatch-supported seminars, workshops, and short courses;
- Tuition reimbursement for PGCC faculty to take graduate-level IA courses that lead to an IA certificate or graduate IA degree;
- Articulation agreement development between two-year colleges and four-year institutions for IA certificates and degree programs;
- Articulation agreement development between high schools and two-year colleges;
- Student IA contests in cyber defense (e.g., CCDC), digital forensics, and security awareness;
- Scholarships, internships, and job fairs;
- K-12 programs for teachers, counselors, and students;
- Outreach and dissemination initiatives to the public;
- Marketing programs to attract new members; and
- Support to CyberWatch members for creating IA programs, developing their curriculum, and guidance on mapping their programs to CNSSTS 4011 and 4013 standards.

Being physically located at the same institution, there is considerable overlap between the faculty members who teach in the AAS in Information Security degree program and the CyberWatch center administrators. PGCC faculty and program administrators are "very involved in all aspects of CyberWatch" (MB, p. 1).

Partnerships with higher education institutions. The process of revising the CyberWatch AAS model curriculum is a collaborative one. Faculty from PGCC involve "academic institutions across the nation in developing IA curriculum which is shared with all members" (CAE2Y Application, 2009, p. 4), with groups of faculty members focusing in specialized areas and then each sharing what they develop. Additionally, "several business members of the CyberWatch Advisory Board" (CAE2Y Application, 2009, p. 4) are involved in curriculum revisions. Despite the discussion of the collaborative process, identification of individuals who are leading the curriculum design in this document as well as in our interviews, leads us to understand that the primary designers of the CyberWatch AAS degree model curriculum are located at Anne Arundel Community College and Prince George's Community College. For that reason, both community colleges were included in our work related to this CyberWatch case study.

Professional and community involvement.

Community outreach. One indicator of quality identified in PGCC's CAE2Y Application (2009) are the variety of efforts made to give students access to IA practitioners. PGCC students take part in cyber challenge competitions that bring them into close contact with cyber professionals and students from other academic institutions in battle competitions in which they attack and defend technology systems. They also have opportunities to participate in career forums, industry field trips, and to hear presentations from guest speakers.

In July 2013, one faculty member added that the competitions and conferences that Prince George's Community College engaged in cooperation with the Defense Cyber Crime Center (DC3) would be discontinued. As he described, "sequestration hit DC3 hard" and these outreach functions had been cut as a result. In response, the CyberWatch organization was actively looking for ways to offer support and fill gaps through other established programs.

Sharing What Works: Educational Significance

Economic and employment needs. Throughout our site visit, we encountered messages from program faculty, administrators, advisors, and other stakeholders stating that information security is one of the fastest growing career areas in information technology, and Maryland has become known as a "global epicenter of cybersecurity" (Senator Mikulski, February 23, 2012). Every organization in the country needs to safeguard their technology systems, and often entry-level information assurance specialists begin their careers with an associate's degree.

Students who were currently enrolled in the Information Security program echoed these messages when discussing their decisions to pursue this degree field. They shared that when looking at economic markets and growth, "the biggest field is information security" (Student Focus Group, Participant 2, p. 1) and "my friends who are computer experts say you need to speak the language – the computer language – to be successful. So, I started just to be more marketable in the job force" (Student Focus Group, Participant 1, p. 2).

Interestingly, beyond this broad sense of information security being a high demand field, PGCC students that we spoke to generally did not seem to have a deep understanding of career options and possibilities. The following excerpt from a focus group conversation is fairly typical of responses to questions about anticipated career paths:

Researcher: What about looking forward? Where are these degrees going to take you? What career areas or jobs are you considering?

Participant 4: I don't really know yet.

Participant 2: IT help desk.

Participant 5: Same thing. Help desk, and then hopefully grow.

Participant 2: In the company, yeah.

Participant 3: Yeah, help desk and then build from there too. (Student focus group, p. 5)

The exception to this tendency was an adult woman in the focus group who had been working in the healthcare field for "so long," and desired to use her education to improve information security in the field that she knew very well – "I see that the compliance is terrible. As far as HIPPA, information is just everywhere. So, I am really interested in it" (Student focus group, Participant 6, p. 4).

Engaging students at various skill levels. Some PGCC administrators described the strengths of degree programs, such as the AAS degree in Information Security, as providing students with varying levels of academic self-efficacy an opportunity to warm up to higher education. Their courses are designed to reach out to students who are "interested in all things technical, and who learn experientially." As students get into the coursework, they "realize that this is kind of interesting. [They would] like to know more and then at that point some of the theoretical underpinnings … begin to emerge" (CLP & MG, p. 3). Students begin to view themselves as capable learners who belong in the college environment and new opportunities emerge that they could not envision previously.

Applied and hands-on learning. "Almost all of the technical courses in the IA degree and certificate programs include hands-on training in the curriculum," whether through the use of commercial web-based applications that "tunnel into virtual machines that have live internet connections and allow the students to perform a variety of [Information Assurance] lab assignments" or within a "face-to-face course taught in a computer lab classroom" (CAE2Y Application, 2009, p. 13). In these classes students are required to demonstrate proficient ability to complete tasks related to laboratory assignments.

Current Information Security AAS degree students who participated in focus groups perceived their courses to be a balance between lecture and hands-on learning experiences: "always 50/50, 50% lecture, 50% hands-on" (Student focus group, Participant 1, p. 7). They expressed an appreciation for the role of lecture – "education is good that will teach you about books" (p. 1). However, they also expressed a desired for additional exposure to hands-on experiences, saying "I wish it was a little bit more hands on" (p. 1).

Online and web-based instruction. All of the courses required for the Information Assurance certificates are available fully online (CAE2Y Application, 2009), as are all electives that are offered within the Information Security department. Additionally, all core classes, with the exception of CISCO courses, are offered online (MB, p. 10). PGCC has integrated the Wimba web application suite into the institution's Blackboard system in order to allow instructors to record weekly live lectures so that students may revisit lectures that they were not able to attend or that they would like to listen to again.

One challenge with online courses is that some students who choose to take online classes do not have the personal discipline and time management skills to be successful in that learning environment (MB, p. 11).

Condensed course schedules. Many courses are offered in 8-week sessions, with two terms provided per traditional academic semester. Program administrators reflect that "students seem to really like that.

You have to sit during lecture a little bit longer; you've got less time to do stuff. But, you get through it quicker; doesn't seem to drag out as long" (MB, p. 10). However, one of the cautions for the condensed course schedule is that students do not have time to catch up if they fall behind on assignments. For this reason, one faculty member stated that he is quite rigid about his policy of not accepting late assignments.

Open-book exams. One faculty member discussed the value of offering timed, open-book exams. The students must be familiar with the material, but the process of looking up the material during the exam "is just as good as a learning tool as trying to make them memorize it … when you have to go look up stuff, you reread it several times in an open book exam, it helps reinforce the curriculum" (MB, p. 11).

Internships. Students are strongly encouraged to participate in internships as a part of their studies (program information PowerPoint presentation). Yet, there appeared to be a gap when we spoke to current Information Security AAS degree program students regarding their involvement in internship opportunities. Students seemed to express interest in internships, along with a lack of understanding on how to get involved in them. One student reflected upon how much he had gained from a one-time, volunteer experience where he had the opportunity to apply what he was learning in classes. He stated that:

Participant 1: I mean, lecture is important, don't get me wrong. But, the real experience. I can share with you folks a couple of years ago I went to a PG Fair, where PG offers computer assistance for people who need it. Back then, I just finished my computer repair classes. Just be there for two hours and deal with real situations. It taught me more in two hours than in six months of classes. So, if ever [students can have] that kind of experience would be also fantastic. (Student focus group, pp. 6-7)

This student expresses a clear understanding of the value of engaging in "real situations" in which he could apply the knowledge he gained in the classroom – essentially, engaging in an internship-type experience, even if it is on a short-term basis. He continues on to express uncertainty regarding how to find internship opportunities, stating:

> We are all trying to get experience. The hands-on [in class activities are] a great experience, but it is a fake hands-on. So, if we would have exposure to some real business. Allow us to do some internship for credit, no-credit. Whatever it might be. That, I think, would benefit our students.
>
> I'm sure the college has some connection, but the more the better. I'm sure there is a lot of growing, especially in the Maryland area, I'm sure there is a lot of security stuff and let's say computer in general, I'm sure there would be people who would be interested to be part of an internship, or whatever. (Student focus group, p. 7)

Uncertainty regarding how to secure an internship position could relate to many factors, such as not knowing where to search for internship opportunities; how to balance internship opportunities with other school, family, or work responsibilities; or how to prepare for an internship. This student is calling upon the institution to play a more substantial role in the cultivation of internship opportunities for students, by building relationships with local employers and potentially building the internship more visibly into the structure of the degree program.

In an interesting, recent development regarding internships, on faculty member shared developments with the US Department of Homeland Security. Prince George's Community College and three other CAE2Y community colleges in the DC area were invited by Janet Napolitano (the Secretary of the US Department of Homeland Security) to participate in an internship program specifically designed for community colleges. Five students from each community college, as well as a few faculty members, were invited to

tour the Department, to learn about internships and career opportunities and to build networks. May 6, 2013 was then the deadline for students to apply for internship opportunities. One student from PGCC was currently engaged in an interview process, with hopes of landing a position. The PGCC faculty member that we spoke with shared that this was a first step towards community colleges breaking into creating opportunities in government agencies. They were hoping to see the National Security Agency take similar steps in the near future.

Supports provided to help students achieve positive results and outcomes.

Dedicated faculty. Within a focus group of current students in the Information Security AAS degree program, students expressed appreciation for the support that they receive from faculty in the degree program. They discussed how courses in the program are well sequenced, with learning experiences flowing from one class to the next, and one instructor to the next. As expressed by one student:

> Participant 2: The funny thing is that every time I take a security class, they always follow-up one another. Like for example if we learn about subnetting in networking, my security class will come and say we're going to talk about subnetting, and I'm like "I just learned that." And, you get to see how they all flow together, cause a lot people are like, we're taking these classes, how do they flow together. And they do all flow together. I like that." (Student focus group, p. 6)

There is a clear flow of communication and ideas throughout the program that students recognize.

Further, students appreciate the attention and time that instructors and professors provide to students on an individual and group basis – "It has been a pleasure to be one of their students. They give you advice. … They work with you." (Student focus group, Participant 1, p. 5).

Low cost, high value. Some current students in the Information Security AAS degree program reflected on the significance of the value of the education they felt they were receiving at PGCC, particularly in relation to the low cost of attendance in comparison to other local higher education institutions. For example, one student stated that:" I don't have money for bigger universities so I said, let's look into PGCC, and I was kind of surprised by the kind of program they have here" (Student Focus Group, Participant 2, p. 1). The affordability of this educational option, coupled with a perception of a quality educational experience, was a strong motivator for students to persist in the degree program. They recognized value in the time and financial investments they were making – a positive return on their investments.

Sharing What Works: Evidence of Effectiveness and Success

Challenges to Gathering Evidence of Student Success. Program administrators at PGCC shared that the call for gathering evidence of student success in the community college environment is fraught with challenges. They reflect that:

> Our student body is so transient. A lot of them are still in the workforce, going to school part-time, or employed part-time or full-time. ... And of course, now that we have nice articulations with UMUC and Capitol College, they don't necessarily have to totally finish their degree before moving on. (MB, p. 5)

It can be difficult to clearly define which students are enrolled in courses with intentions to complete the AAS degree in Information Security, much less to determine how many successfully reach those goals. Students are not required to declare a major until the semester in which they intend to graduate. Without

such a requirement, students are not motivated to follow through on this administrative step, and the "ones that have declared to be majors are very low" (MB, p. 5). Providing an accurate count of how many Information Security majors exist at PGCC in relation to student intention is difficult. An unduplicated headcount of students enrolled in information security courses was provided (482 students at the time of our visit in March 2012), with the caveat that this includes students who are taking information security courses as electives for entirely different degrees. One program administrator reflected that "for the most part, we find out the successes of our students when they come back" (MB, p. 14) and share information about where they have gone after their PGCC experience.

It is equally (or perhaps even more) challenging to track student successes beyond their experiences at PGCC. Faculty and administrators at PGCC do not have effective methods for tracking statistics related to the bachelor's degree programs to which their AAS degree graduates (or non-graduating students) transfer. Program administrators believe that "the largest number of [AAS degree] graduates" in Information Assurance who chose to pursue a bachelor's degree attend UMUC. For graduates who seek work after attaining their AAS degree, employment is difficult to track, yet anticipated to be very good. As described by one program administrator:

> The job market here is extremely good … Anybody that gets, even an associate degree in this field, we pretty much get a zero unemployment rate. Someone is going to hire them, whether it's the government or industry. We have the new cybersecurity command that just went into Fr. Meade; DISA just moved there, along with a couple other agencies. All of them require security type people for their infrastructure. (MB, p. 14)

This information on employment is reported quite strongly, however, it is primarily based in anecdotal reports – "the ones I've known" (MB, p. 14). There are also only a small number of graduates to track, as this is a relatively new program, started only 5 years before our visit. One program administrator reported that there had only been approximately 10 graduates in the past two years, since the program received its CAE2Y designation. There was some suggestion by campus administrators that it may be "too soon to tell" regarding the outcomes or impacts that the AAS degree program in Information Security and the degree pathways created by articulation agreements with bachelor's degree programs have on individual students (CLP & MG, p. 1).

Evidence offered as demonstration of success.

Success in regional and national competitions. PGCC's CAE2Y Application (2009) lists successes that students experienced in regional and national competitions. A PGCC student placed second in the 2009 national Educause competition. In the Forensic Cup Competition hosted by CyberWatch, PGCC placed first in 2008 and tied for first in 2009.

Discussing competition success as a whole, PGCC program administrators reflect that they are doing well within the limitations for their institution. In some of the competitions, their 2-year community college students are competing against teams that include bachelor's and graduate degree students who have more years of training and technical skill to draw upon. Additionally, many of the competitions are held during normal business hours (e.g., on Friday afternoons). This schedule is difficult for community college students who work, and as a result, PGCC is not always able gather a full team to participate. Finally, finding faculty mentors to coach teams can be a challenge, since coaching is an extra, often unrewarded, activity.

Student reflections in focus groups (anecdotal). Within a focus group, one student expressed that within his Information Security classes he had learned to change the level of depth with which he engaged material presented in classes. He expressed:

Participant 3: Before I got to computers it was all reading and math. I guess you didn't necessarily have to know the stuff. Just do what you have to do to get the grade. That's how my mentality was. Just do it, get the grade, move on. When I got to computer security, I couldn't just… I had to actually know the material, and to read, and to know more than just to get by. To actually knowing the stuff… I'm still working on it. ... it's just that I have to do more. (Student Focus Group, p. 6)

This deep engagement with course material remained "a challenge" for this student at the time of our focus group. Yet, his reflection demonstrated his personal development, and movement to a more mature and thoughtful level of engagement. Other students echoed these ideas that they were inspired to learn when they found practical connections to and personal interest in the course material. Some examples include:

Participant 2: My parents just said that information security is a growing field. And, I just said okay, let's get into this thing and I'm like it's going to be good money. But, when I actually got into it, I'm like "this thing is awesome." And then when I got into the security things, I'm like "I actually get this thing. I actually do this… it's awesome." (Student focus group, p. 6)

Participant 6: I didn't really start learning something new until probably this semester … First I was just taking computer information systems because I didn't have a real major that I wanted to do. But then my computer security, I got into that, and operating systems. … Only this semester I'm learning new things that apply to my degree, like computer forensics and cybersecurity. ... Once I grasp it, understand it, I'm like "Yeah, let's keep going." (Student focus group, p. 5)

University of Maryland-University College's Bachelor of Science (BS) in Cybersecurity

As denoted by the first part of the institution's name, University of Maryland-University College (UMUC) is a part of the University System of Maryland, which is made up of 12 universities, 2 regional centers in which resources from several universities are brought together, and a system office located in Adelphi, MD. As denoted by the second part of UMUC's name, UMUC is a "University College" which offers educational opportunities "outside of the university's walls and normal class times" (http://www.experienceumuc.com/2012/06/whats-with-name-umuc-lot-actually.html, Feb 1, 2013). From its beginnings, UMUC was dedicated to meeting the needs of students who needed to balance their education needs with family and work commitments. The first classes were offered in 1947, addressing the needs of GIs returning from World War II. In 1949, at the request of the U.S. Department of Defense, UMUC became the first institution to send educational teams overseas to teach college classes to active-duty service members on military bases in post-war Germany. Today, UMUC remains a leading provider of higher education to U.S. military, enrolling 55,000 active-duty service members, reservists, National Guard members, veterans, and their families.

In the 1990s, UMUC became the first U.S. university to offer online degree programs, allowing them to deliver educational programs to students all over the world. This again allowed the institution to expanded their reach in working with military personnel and families abroad, as well as to reach out to additional population such as working professionals and single parents who may have difficulty commuting to a college campus.

Today, UMUC courses are taught primarily online, with approximately 80% of student enrollments being fully online. The university has no physical campus of its own, but does hold some physical classes in the UMUC Academic Center in Largo, MD., as well as in approximately 20 physical sites across the States of Maryland and Virginia, as well as in Washington, D.C. The largest location for physical classes is University of Maryland College Park, where a series of evening classes are held.

UMUC's mission is to operate as Maryland's "open university, serving nontraditional students who reside in Maryland, the United States, and around the world" (http://www.umuc.edu/visitors/about/mission.cfm). Terms and phrases that are used on the institution's website to describe the educational opportunities offered by their institution include: respected, affordable, accessible, top-quality, "setting the standard of excellence in adult education," "broadens the range of career opportunities," improving lives, maximizing economic and intellectual contributions that students can make, and "continuing as a leader in distributed education." The mission focus on adult students and career preparation lends itself to an emphasis on workforce-relevant degree program offerings. However, academic degrees and certificates are offered in a wide variety of fields, including arts and humanities, behavioral and social sciences, business and management, health-related fields, computing, education and technology, cybersecurity, information assurance, and teacher training in STEM areas.

UMUC Current Students

UMUC currently boasts the largest enrollment of any U.S. public institution. The 2012 Fact Book (http://www.umuc.edu/visitors/about/ipra/upload/FactBook_FY12_1-8-2013.pdf), reports that 97,001 undergraduate and graduate students enrolled during the 2012 fiscal year, attending courses in more than 150 locations worldwide. The institution is approved to award certificates, associate degrees, bachelor's degrees, master's degrees, and doctoral degrees, in more than 100 programs. Approximately 70% of undergraduate and graduate students are employed full-time, and an additional 9% are employed part-time. Just over one-third of students (36%) are enrolled as full-time students. In the 2012 fiscal year, 9,454 degrees were awarded. Of these degrees, 12% were associate degrees, 51% were bachelor's degrees, 36% were master's degrees, and 1% were doctoral degrees.

Seeking information specifically on undergraduate students, we gathered statistics from the NCES' IPEDS College Navigator. The most recent data available was for Fall 2011, in which undergraduate enrollment is listed as 28,119 students. Approximately 80% of these students were reported as attending school part-time, and 20% were attending full-time. Female students made up 53% of the undergraduate student population, with 47% of students reporting as male. A total of 41% of the undergraduate student body self-identified as White/Caucasian, 33% as Black or African American, 8% as Hispanic/Latino, 4% as Asian, 2% as two or more races, 1% as American Indian or Alaska Native, and 1% as Non-resident Alien. Race/Ethnicity unknown was reported for 10% of undergraduate students. In regards to age, 82% of students reported being 25 and over, and 18% reported being 24 or younger. Two-thirds (67%) were in-state students, 33% were out-of-state students, and 1% were from foreign countries.

IPEDS data for undergraduate student retention and graduation rates are not particularly helpful in the case of UMUC. These rates are calculated based on the progress of students who begin their studies as first-time, full-time degree or certificate-seeking students to see if they complete a degree or other award within 150% of "normal time" for completing the program in which they are enrolled. However, the UMUC student body, particularly the bachelor's degree-seeking students, is composed of a large number of transfer students. In fact, only 2% of entering students were counted as "first-time, full-time" in 2011. Of those first-time, full-time students, 12% graduated in 150% of "normal time" toward their intended degree and 21% transferred out. Again, these numbers are to be interpreted with caution, as they do not speak to the experience of the large number of transfer students.

In response to the limitations of the IPEDS data for the UMUC student population, UMUC examines 5-year and 10-year graduation rates for its own set of undergraduate subgroups that better represent the diverse set of students that the institution enrolls. Table 10 presents the findings of those graduate rate studies for cohorts of students who began their studies at UMUC in Fall 2001 and Fall 2006. These data are reproduced from a table presented in UMUC's Undergraduate Student Profile, and demonstrate the complexity of the question of examining graduation rates with a non-traditional student population.

Table 10. Graduation Rates for Key UMUC Undergraduate Subgroups

Student Group	Cohort	Definition	5 year rate	10 year rate
New to UMUC, all undergraduates	Fall 2001 3,256 students	All full time and part time students (new freshmen and transfers) who are new to UMUC and starting in the Fall	24%	32%
New to UMUC, re-enrolled undergraduates	Fall 2001 1,984 students	All full time and part time students (new freshmen and transfers) who are new to UMUC and starting in the Fall and reenrolled in the Spring semester	36%	46%
First time, Full Time	Fall 2006 152 students	First time, full time, degree seeking students who are new to college, started in the Fall and received their first bachelor's at UMUC	3%	
First time, Part time	Fall 2006 849 students	First time, part time, degree seeking students who are new to college, started in the Fall and received their first bachelor's at UMUC	2%	
Transfer students transferring more than 60 credits, reenrolled	Fall 2006 1,637 students	New fall transfer students with more than 60 transfer credits who re-enrolled in the Spring.	44%	
SOC Military transfer students	FY 2006 663 students	Military students who transferred 9 credits or more and completed 3 courses at UMUC between FY 2005 and FY 2006.	53%	

Note:

1) SOC – Service Member's Opportunity College. SOC cohorts completed their third course in the FY 2006, the starting year for counting their graduation rate. Produced by the Office of Institutional Effectiveness. Data are current as of Fall 2011. Produced 02/16/2012.
2) Undergraduate tuition for Maryland residents in fiscal year 2012 was $251 per credit hour, with an additional $15 per credit hour technology fee.

A UMUC academic administrator shared that "UMUC's primary mission is to adult students" (CD & JT, p. 1). A large number of students are in the military, and 90% are working, often times "already in the field they want to get the degree in" (CD & JT, p. 1). As such, UMUC caters to a non-traditional student population. There are no dorms on campus, and no residential life. In some ways, this alleviates some of the challenges

that a traditional college or university may face – "We don't have to deal with that side of students. The drinking, the dorms, the football games." (CD & JT, p. 13). However, working with non-traditional, adult students brings another set of challenges. As described by one university administrator, these students "tend to be more knowledgeable… argue to us more… they're consumers," as compared to traditional students (CD & JT, p. 15). She vividly described how, upon coming to UMUC, she was surprised by her student interactions:

> I had never been in a place before where student complaints come in in binders with tabs. You know, they're doing a professional presentation, and they know that if they complain they might get something – 18-year-olds – you know, it's a different relationship." (CD & JT, p. 15)

There are very few students at UMUC that transition directly from high school. In fact, UMUC does not direct it's recruiting efforts toward high schools. Rather, they shared that "the place we go to recruit is community colleges" (CD & JT, p. 12) to seek transfer students.

Transfer has consistently been an important part of UMUC's story throughout the institution's history. Nearly 40% of their students are first-generation college students in their families – something that is "very typical of community colleges too" (CD & JT, p. 15). University administrators acknowledged that UMUC students typically have a history of "[going] in and out of education" over a period of time. Nearly all students bring in some transfer credit, and administrators estimated that "about 60% [of students] bring in about half of the [bachelor's] degrees" (CD & JT, p. 1). There exists a palpable enthusiasm regarding community college transfer students at UMUC. As expressed by one university administrator:

> Community college students are our best students sometimes. They've gotten the experience, they know how to be a student, they're on a pathway, they're thinking ahead… The community colleges focus on the type of students that we have … that we want to serve. (CD & JT, p. 1, 14)

What makes community college students so attractive to UMUC is the training and attention that they have received during their community college experiences. During their time at the community college, students learn to negotiate the academic environment. They build foundational skills to understand the language of academic institutions, to avoid issues with plagiarism, and to complete any necessary remedial coursework in writing, English, and mathematics. All of these achievements contribute to "the resilience of the student" (CD & JT, p. 14) – the ability of the student to successfully persist to their goals in the university environment. As described by UMUC administrators and faculty, the students who struggle at UMUC, or the ones who are "weak academically," are those who "come directly to us, so maybe they've been working in a field a long time and decided to come back to school" (CD7 JT, p. 15). The community college students, on the other hand, "have good foundations and then, they know how to pick classes. They know what to do to graduate" (CD & JT, p. 15).

University administrators shared that "there is a big difference between accepting [community college transfer students] and encouraging them" (CD & JT, p. 27). These administrators hold the perception that many universities accept transfer students, but are not particularly enthusiastic about engaging students with "sub-degrees" (CD & JT, p. 2) in deep and meaningful ways. They treat the community college as "an inferior education and they kind of look down on it" (CD & JT, p. 16). UMUC, on the other hand, "does not see students' [sub-baccalaureate degree experience] as a barrier in any way" (CD & JT, p. 2). Rather, UMUC focuses on the strengths of community college experiences as outlined above, including, minimal remediation needs, increased knowledge of higher education language and norms, improved academic and career focus, and so on. They shared their views that four-year schools do not have the capacity to cater to the needs of all students, and that students need less expensive routes to higher education. Therefore, "students are increasingly seeing starting at community colleges as an important way to start" (CD, JT,

p. 16). This is demonstrated by UMUC's "very active community college scholarship program… and community relations department whose whole purpose is to help community college students interface with [UMUC]" (CD & JT, p. 1).

Furthermore, UMUC university administrators find that "if [students] bring over 45 credits, it's a big divider; they are more likely to persist and succeed" (CD & JT, p. 15). Therefore, students are encouraged to complete their associate degrees, when feasible, prior to their transfer to UMUC's degree programs. For those students who have not completed an associate degree prior to transfer, UMUC "actively approaches them to… get that credential" (CD & JT, p. 6) through reverse transfer opportunities. Reverse transfer associate degrees are viewed as positive opportunities from many angles – helping community colleges improve their completion statistics, while helping students earn a credential and the feeling of accomplishment without stopping them from "moving forward if they want to take courses [at UMUC]" (CD & JT, p. 5).

Comparison to Other Higher Education Institutions

UMUC places a strong focus on "workforce relevant degrees" (CD & JT, p. 27). Of central importance in designing their degree programs is the question of "what are the concepts, skills and abilities that [students] would need to have" (CD & JT, p. 27) to complete related jobs.

Additionally, degree programs at UMUC are constructed "specifically to be welcoming of transfer credit and of associate degrees… this is a very important part of who we are" (CD & JT, p. 1). UMUC has articulation agreements and "very strong relationships" (CD & JT, p. 1) in place with more than 80 community and technical colleges across the U.S. UMUC administrators also expressed that many students who begin at community colleges do so "thinking it will be [a] terminal [degree], and then, they realize they need more, and they want to get a 4-year degree" (CD & JT, p. 1). For this reason, they find it important to seek ways to articulate applied associate degrees (for example, the Associate of Applied Science), in addition to the more traditional transfer associate degrees of the Associate of Arts and the Associate of Science. In fact, there are some bachelor's degree programs offered at UMUC that essentially are only transfer degrees. As described by one university administrator:

> We actually have a couple of degrees that are only transfer degrees. They started out as what we call Bachelor of Technical and Professional Studies, which basically requires the Associate of Applied Science first. And we have those in bio technology and in lab management because we don't have the hands-on science as much, but we can put the management aspect on top of it. (CD & JT, p. 1)

The BS in Cybersecurity Degree Program

At the time of our visit in March 2012, UMUC's undergraduate and graduate degree programs in Cybersecurity were just two years old, having been introduced during the 2010-2011 academic year. The program area has been "very fast-growing… the minute we introduced it, it really started taking off." In the Spring 2012 semester, nearly 7,000 students were enrolled in the undergraduate and graduate programs together. There were close to 70 course sections being offered in Cybersecurity, all being delivered in online environments, with many students from UMUC's five other computing major degrees electing to take cybersecurity courses as part of a cyber minor. (Program administrators shared that UMUC strongly encourages students to explore interdisciplinary degrees.) Within its first two years of existence, 42 students were on schedule to graduate from the Cybersecurity BS degree at the end of Spring 2012. As these degree completions are quite early, considering the new development of the degree program, there was some speculation among university administrators that some of these graduates may be individuals who had

transferred over to the Cybersecurity degree from other majors (e.g. Information Assurance). Data were not available on these upcoming potential graduates at the time of our visit in March 2012. One faculty member reflected on the size of degree programs at UMUC, sharing: "When I came here, it really opened my eyes to the scale and scope of UMUC. A small program is a program that other schools dream to have that number." (CD & JT, p. 19).

Developing the B.S. in Cybersecurity Degree Program at UMUC. UMUC's Department of Computer Information Systems and Technology offers six undergraduate majors, four minors, and one certificate program (See Table 11). Program brochures stress the benefits of learning from "faculty's years of real-world experience" as well as "gaining hands-on experience" through the application of skills learned in the classroom (Undergraduate School Brochure, p. 8; http://www.umuc.edu/undergrad/upload/2012-2013_Undergraduate_Prospect_Brochure.pdf).

Table 11. Programs offered by UMUC's Department of Computer Information Systems and Technology

Majors	Minors	Certificate
Computer and information science	Computer science	Computer networking
Computer networks and security	Cybersecurity	
Computer science	Digital media and Web technology	
Cybersecurity	Information systems management	
Digital media and Web technology		
Information systems management		

The Cybersecurity major was developed with input from an advisory committee, and courses and competencies are aligned with national standards. The curriculum teaches graduates to be "leaders in the protection of data assets" (2011-2012 Undergraduate Catalog, p. 20). Courses focus on the techniques, policies, operational procedures, and technologies that secure and defend information and information systems. Interpersonal and management skills are also addressed. Suggested career paths for graduates of this program include information systems security professionals, senior systems managers, or systems administrators.

An articulation agreement exists between UMUC's School of Undergraduate Studies and the Graduate School of Management and Technology that allows eligible students who complete a BS in Cybersecurity at UMUC to reduce their total coursework for the MS in Cybersecurity or Cybersecurity Policy by three courses, or 18 credit hours (2011-2012 Undergraduate Catalog, p. 20).

The full BS degree program was developed centrally at UMUC, using a process called SEGUE, which stands for Supporting Educational Goals for Undergraduate Education. The SEGUE Process is used for all academic programs at UMUC, to ensure that they are "outcomes-focused, with course outcomes aligned with program and college-level learning goals" (http://www.umuc.edu/upload/UMUC_Team_Visit_Report_8-2012_Final.pdf, August 2012). Within the SEGUE process, outcomes are first defined for each degree program and a Program Outcomes Guide (POG) is prepared, which serves as a "map of the program" (CD & JT, p. 2). Individual courses are then developed with course learning outcomes that must map to both the degree program outcomes and a set of "hallmarks of the educated person" (http://www.

umuc.edu/outcomes/upload/Inst_Plan_2010.pdf, June 2010). The "Hallmarks" are a set of institution-level learning outcomes for all undergraduate students (see Table 12). Individual course outcomes are required to be included as part of each course syllabus. Once individual courses and course outcomes are determined, faculty teaching guides are developed which include detailed information on how a course is to be taught, including: a course description; intended course outcomes; learning goals; information about how the particular course fits into the broader curriculum; a course syllabus with model course projects, assessments, and assignments; and information on grading policies, academic integrity, and other relevant policies. A variety of faculty supports are then put in place to "assure that defined course outcomes consistently form the basis for teaching and assessment of student learning" (http://www.umuc.edu/upload/UMUC_Team_Visit_Report_8-2012_Final.pdf, August 2012).

Table 12. UMUC'S Institution-Level Learning Outcomes for Undergraduate Students*

Hallmarks of the Educated Person
▪ Effective writing and oral communication skills
▪ Competence in the use of information technology
▪ Competence in information literacy skills
▪ Competence in mathematical and quantitative reasoning skills
▪ Competence in critical analysis, critical reasoning, and problem solving
▪ Understanding of key concepts and principles of the natural, social, and behavioral sciences
▪ Knowledge of diverse cultures and historical periods
▪ Understanding of frameworks for ethical decision making and the ability to apply them

*2011-2012 Catalog, School of Undergraduate Studies

Degree program learning goals and objectives. As outlined in the 2011-2012 Undergraduate Catalog, the intended learning outcomes state that graduates of the BS in Cybersecurity degree program will be able to (p. 20):

- Protect and organization's critical information and assets by ethically integrating cybersecurity best practices and risk management throughout an enterprise.
- Implement continuous network monitoring and provide real-time security solutions.
- Analyze advanced persistent threats and deploy counter-measures and conduct risk and vulnerability assessments of planned and installed information systems.
- Participate in forensic analysis of cyber incidents and assist in recovery of operations.
- Formulate, update, and communicate short- and long-term organizational cybersecurity strategies and policies.

Curriculum design. The BS degree program in Cybersecurity requires 120 credit hours of coursework, which includes 33 credits for the major, 41 credits in general education coursework, and 46 credits in the minor, electives, and other degree requirements. At least 17 credits in the major must be earned in upper-level courses numbered 300-level or above.

University administrators pointed out that there is a distinct difference in the way that UMUC partitions its credit hour requirements in comparison to other universities. Other universities generally require 45 to 60 credit hours to be taken within the major coursework for the bachelor's degree. UMUC bachelor's degrees, however, require on average 30 to 38 credits of major coursework, with more credits generally added to the minor credit hour requirements than other institutions. Within that minor areas is "where we put a lot of transfer credit that comes in," (CD & JT, p. 5) including technical credits from AAS degree programs. Leaving many options for students to fill electives provides flexibility to "preserve the integrity of the major," while avoiding situations in which "students [would] lose credit just because there's not an exact match" in a particular curriculum (CD & JT, p 8).

Math requirements. One mathematics course is required for the BS degree, Math 106, which is Finite Mathematics. This may be substituted with a higher-level math course.

Articulation agreements. University administrators and program faculty shared that "when CyberWatch came along specifically to encourage the articulation" with their model AAS degree program in Cyber Security, thinking in terms of institutional mission and student populations, UMUC was "a natural fit" (CD & JT, p. 1). UMUC's historical focus on community college transfer, design of bachelor's degree programs to accept AAS degrees, and focus on workforce relevant degrees, all dovetail quite well with the types of associate to baccalaureate degree-granting institution relationships that CyberWatch is looking to build. UMUC was the first baccalaureate degree-granting institution to develop an articulation agreement with the CyberWatch model AAS degree program, and administrators shared that they were "really very excited about the chance to do that" (CD & JT, p. 1).

In regards to the alignment of the actual curriculum in the CyberWatch model AAS degree program to the UMUC BS in Cybersecurity degree program, the UMUC faculty report that it "doesn't fit very well – CyberWatch is very technical in nature; while our cybersecurity is policy-based" (CD & JT, p. 7). The reason that they are able to make the articulation work is due to the way that UMUC structures degree programs with only 30 credits specified in the major course requirements in cybersecurity. Despite the mismatch in the focus of the AAS and BS degree programs, students "still only have to take 60-some credits at UMUC to complete their bachelor's degree" (CD & JT, p. 7) because all of the community college credits can be incorporated, just not in the major itself. One UMUC faculty member described their program as having "a pretty big elective bucket [where] we don't even say what the courses are… and that's even after us specifying even the gen eds" (CD & JT, p. 9). The 43 credits specified for electives can be taken as a minor or electives. Students are encouraged to define a minor area to focus in, but it is not required.

Despite having articulation agreements with CyberWatch and many other community colleges across the country, UMUC always articulates a student's transfer credit on a course-by-course basis. University administrators shared several reasons behind this strategy, beginning with the concern that:

> We make sure that [the course] addresses the same outcomes as our course would… we're really conscious that there may be more integration through [our] program than they have in theirs, and that's why we require half of the courses be from us, so we can be sure they get it, the hallmarks [of the educated person]. (CD & JT, p. 3)

Beyond ensuring that UMUC's program and course learning outcomes are addressed, there is a concern that students receive an accurate credit reflection based on their past experience, which can be quite varied. It is quite common for students to bring "five of six different transcripts [and] military credit or prior learning credits," as well as credits from an AAS degree program that "does not have as big a gen ed block" as a typical BS degree program requires (CD & JT, p. 3). The variety in sources of credit (e.g., portfolio, ACE-evaluated credit, industry certification exams) creates a situation in which the variation across students

creates many unique cases. Therefore UMUC's student database is "set up around the idea that you place [students] course by course" (CD & JT, p. 3) to best meet their educational needs and gaps. As a result, rather than their articulation agreements being a promise of a specific course-by-course alignment arrangement for all students, articulation agreements become more of a "promise that we'll take it" (CD & JT, p. 3). As described by one university administrator, "the key is that we make a concerted effort to work with community colleges … we want to make it work" (CD & JT, p. 26).

To facilitate transfer, UMUC has "a very large operation evaluating transfer credit (CD & JT, p. 3), and the advising is "very technical" (CD & JT, p. 9) requiring a professional advising staff, rather than faculty academic advisors. Up to 70 credit hours are accepted from a community college. Worksheets are available online and from academic advisors for every community college and every program with which UMUC has a relationship. UMUC does accept lower-level equivalents of upper-level courses. However, students would need to fulfill upper-level course requirements with other courses, meeting the State of Maryland minimum rule that students complete at least 45 upper-level credits. Capstone classes are never accepted as transfer credits, as they are "intended to be an integrative experience" (CD & JT, p. 3) and should therefore be taken near the end of a student's bachelor's degree program at UMUC. Finally, across the board with all UMUC degrees, half of the degree credits must come from UMUC.

One university administrator likened the transfer credit process to a jigsaw puzzle, attempting to account for many rules and moving pieces. Yet, in the end, taking this approach was viewed a most valuable for the students.

> A lot of this is just the necessity of dealing with the types of students [who enroll at UMUC]. They take a long time to finish. They come from various places. They bring a lot of experiential credit. There's a lot of state rules about how much credit we can give for experiential credit, for internships, for ACE evaluative credit, and so, we're juggling the different buckets all the time. I would really like to have it be a little more coherent in some ways, but when you're dealing with this type of student and the regulations on top of it, it's kind of a jigsaw puzzle. You're doing a credit by credit match. And in the end, it serves the students better than having the ideal picture of how it would fit. (CD & JT, p. 9)

Student Enrollment and Demographics

We heard some potentially inconsistent data regarding enrollment in the undergraduate and graduate cybersecurity programs at UMUC. According to UMUC's website (http://www.umuc.edu/visitors/about/ipra/glance.cfm), in Fall 2011, UMUC had enrolled more than 2,500 students in the undergraduate and graduate Cybersecurity programs. Within our interviews with faculty within the Cybersecurity degree program, we heard verbal reports that, in the Spring 2012 semester, nearly 7,000 students were enrolled in the undergraduate and graduate programs together. The discrepancy between these two numbers leaves us with some questions. Yet, at either rate, they are still quite large enrollment numbers for a program that has been in existence for only two years.

Students enrolled in the Cybersecurity degree program are "mostly working adults" (CD & JT, p. 12). The average age of students is 33. One faculty member shared that this creates an interesting situation when UMUC faculty are approached by employers looking to hire new talent – "When a company comes to us and says we want to hire our graduates, we used to have to turn them away mostly because most of our students already have a job." (CD & JT, p. 12). That said, although many of their students are working, students may not be working in the field of Cybersecurity, may be looking for a degree change, or may be seeking a degree as a step toward seeking a promotion. Particularly with Cybersecurity being such a new

and evolving field, it may be "less likely [that students are] already working in it, but they are working in possibly a computer-related field" (CD & JT, p. 12). Many of the students in UMUC's Cybersecurity degree program have government or military backgrounds – the program is viewed as "a real natural [fit] for a lot of military occupations" (CD & JT, p. 12).

In terms of demographics, enrollment in the computer fields tends to be more heavily dominated by male students than female students. While exact numbers were not available at the time of our visit for the Cybersecurity program, the proportion of male to female students was expected to be very similar to UMUC's old information assurance program, as many of those students transferred over into cybersecurity.

A faculty member in the Cybersecurity program reported that many of the cybersecurity associate degree transfer students "end up switching majors [at UMUC] to Computer Network and Security" (CD & JT, p. 23). This is because the students come from a technical AAS degree program and want to continue to pursue a technical bachelor's degree, which the Computer Network and Security degree offers, as opposed to the policy-focused Cybersecurity degree program. This faculty member suggested that some of the difficulty might stem from the lack of definition in the cybersecurity field – students coming into the cybersecurity degree program do not have a good understanding of the program content. The CNS degrees, on the other hand, have a longer standing history and "are much more defined" (CD & JT, p. 23). A university administrator added her reflections that the tendency to change majors in bachelor's degree program is not unusual at UMUC. She shared that "adult students change majors a lot, too, especially since we don't admit to a program. We just admit to UMUC and then you declare a major, so you can just switch very easily" (CD & JT, p. 23).

Faculty Roles and Positions

There are no tenure-line faculty at UMUC, and very few full-time faculty. Most instructors are adjunct faculty, "though they do have rank" within their status as adjunct faculty members (CD & JT, p. 11). Adjunct faculty are valued for what they offer as working professionals – what they bring to the classroom as practitioners "says something very different to students" (CD & JT, p. 11) than solely relying on career teachers.

There is only one full-time faculty member who coordinates both the Cybersecurity degree program and the Computer Network and Security degree programs. During the spring 2012 semester, this included coordinating approximately 180 course sections, which was "one of the smallest areas at UMUC" (CD & JT, p. 18). Approximately 70 adjunct faculty members teach the cybersecurity courses. They hold professional positions as computer scientists, IT specialists, software engineers, IS engineers, system administrators, and project managers in organizations such as IBM, Sun Microsystems, the National Institutes of Health, Booz Allen Hamilton, and the U.S. Census Bureau. Many hold advanced degrees, as well as industry IT certifications from vendors such as Microsoft, Oracle, Sun Microsystems, and Cisco.

Because faculty are often experts in the field or industry, rather than in education pedagogy, high support is provided for course development and delivery. Faculty teaching guides are provided for each course, which include a course description; intended course outcomes; learning goals; information about how the particular course fits into the broader curriculum; a course syllabus with model course projects, assessments, and assignments; information on grading policies, academic integrity, and other relevant policies; and so on. Adjunct faculty are welcome to make some edits to these materials, "but cannot change the course outcomes" or other fundamental course architecture (CD & JT, p. 11). There is also a mandatory sequence of training offered by the Center for Teaching and Learning at UMUC that all

adjunct faculty must complete before they can staff a class. University administrators shared that "through this training, [new faculty] learn about our system, you learn about our learning model, they learn about how to deal with working adults, with the military students, and once they complete all that, then they can teach" (CD & JT, p. 12). The training is also tailored to the environment in which instructors will be teaching in -- online vs. hybrid online and classroom teaching environments.

Sharing What Works: Program Quality

Although not discussed it in great detail (as other institutions did in this case), UMUC representatives did mention that the BS in Cybersecurity degree program "was developed with the aid of an advisory committee and in alignment with national standards" (see Tip Sheet for B.S. in Cybersecurity).

Sharing What Works: Educational Significance

Online Instruction. Faculty for the BS degree program in Cybersecurity seem to prefer to teach online – "the course is the course regardless; they get the same teaching guide. They have the same outcomes; the requirements are the same" (CD & JT, p. 10). Online courses are capped at 32 student participants. The target is 30 students per class, yet a buffer is allowed during enrollment periods in the likely event that students drop the course after the beginning of the term. The online format makes academic planning and scheduling quite fluid and flexible for administrators. Only one course section is opened at a time. As soon as it is filled, a new section is added to accommodate additional student registrations. This means that registrations for online courses do not have the variation and restrictions faced with physical course, which are limited by the availability and size of classroom space.

The challenge with online education is that it is "a lot more difficult to develop a new course" in this environment, as compared to a traditional face-to-face classroom. In the traditional classroom, the faculty member simply picks up a new textbook, and begins to draw out his/her notes and activities. Building an online class at UMUC, however, requires a team of instruction designers, graphic designers, programmers, and content experts, to bring the material to life on their own proprietary software system. Anything that is put online is "team-designed and developed in-house" (CD & JT, p. 10) which can be a time-consuming process.

Experiential Learning Options. UMUC also stresses a variety of experiential learning options for students that recognizes the variety and range of college-level learning experiences that adult students may have previously engaged. Students may earn a limited amount of credit for previous education, work experience, and learning outside the classroom. Some examples of the recognized credit options are outlined in Table 13 (http://www.umuc.edu/undergrad/creditoptions/).

Table 13. Examples of Recognized Experiential Learning Options Recognized by UMUC*

Option	Definition	Maximum Credit	Brief Description
Prior Learning Assessment	Credit earned for learning from prior work and life experience	Up to 30 credit hours	Students take a 3-credit course to aid them in developing a portfolio to document prior learning experiences. The portfolio is evaluated by faculty and up to 18 credits may be awarded. Following the course, students may develop and submit additional portfolios for the potential of up to 30 total credits from prior learning.
Workplace Learning Program	Earn credit for on-the-job learning	Up to 15 credit hours total, no more than 6 credit hours per semester	Apply classroom theory to real-world professional projects to earn credits for upper-level courses. Submit academic assignments about the workplace learning experience for review by a faculty mentor.
Alliances with Community Colleges	One curriculum plan for earning an associate degree and a UMUC bachelor's degree seamlessly	Up to 70 applicable community college credits from a Maryland community college will apply to the UMUC degree	Transfer credit worksheets are provided for all linked degree programs at participating community colleges.
Credit by Examination	Course credit given for successful completion of exams such as the College Level Examination Program (CLEP), Advanced Placement, or UMUC Course Challenge Examinations.	Up to 60 credit hours	UMUC may award as many as 60 credits by examination toward the bachelor's degree, provided that (1) there is no duplication of other academic credit, and (2) the scores presented meet UMUC standards based on the timeframe examination was taken.

*Information gathered from: http://www.umuc.edu/undergrad/creditoptions/)

Supports provided to help students achieve positive results and outcomes.

Financial assistance. The Maryland Community College Transfer Scholarship Program offers support to "outstanding graduates of Maryland community colleges" (http://www.umuc.edu/students/aid/scholarships/otherscholarships/ccsp/maryland.cfm). Eligible students include those who are pursuing their first bachelor's degree, who have earned an associate degree prior to the beginning of their first semester at UMUC, have a minimum cumulative GPA of 3.0 from a participating community college, and are not already receiving 100% employer tuition reimbursement. Full-time student may be awarded $3,300 per year, renewable for one year. Part-time students may be awarded $1,650 per year, renewable for up to three years. The scholarship is automatically renewed, without the need to reapply, as long as the following criteria are met:

- Students maintain 3.0 GPA
- Full-time recipients enroll in at least 12 UMUC credit hours each fall and spring semesters and earn at least 30 credit hours per academic year.
- Part-time recipients enroll in at least 6 UMUC credit hours each fall and spring semesters and earn at least 15 credit hours per academic year.

University administrators expressed that the goal of this scholarship programs was to "close the gap between community college tuition and our tuition" (CD & JT, p. 16). Additionally, the scholarship is accessible to many students: "As long as you graduate with a 3.0 or 3.5 GPA and you're going to school full time at UMUC, most of the time [students] get it" (CD & JT, p. 16). During the 2011-2012 academic year, university administrators estimated that close to $11 million was provided to students through this scholarship program alone.

Career services and assistance. UMUC has a career center that students can access, but "it is not a sort of traditional career center" (CD & JT, p. 18) that might be found on many college campuses. There are some resources on first-time job searches, training materials, job postings, and virtual job fairs. Yet, this is only a small part of what they offer. Because most of their students are employed, their resources do not focus on 'how to land your first job.' Rather, the issue is to help students think about career planning, networking, and building a pathway for their next steps.

University administrators and faculty also spoke enthusiastically about the role that adjunct faculty and alumni networks played in helping students find internships and full-time positions in the Cybersecurity field. Alumni were reported to "come back to us all the time to recruit students" (CD & JT, p. 17), while we also heard that "the best students change jobs all the time because their faculty recruit them" (CD & JT, p. 17). Early access to talent is viewed as an "unwritten benefit" of being an adjunct faculty member (CD & JT, p. 17). As described by one faculty member:

> Maryland is the center for cyber security anyway, with NSA, the DC3, all basically within 50-miles radius from us here. So we do build a partnerships with each one of them. Our faculty come from those organizations. So imagine if you were a network manager working at this organization a short distance from me, and you came across one student that's really good. There's nothing to prevent you from saying to the students, "Hey, I work at this. Send me a resume." And our faculty do that. (CD & JT, p. 17)

Student clubs and organizations. Program administrators and faculty described their Computer Club as "a big source of career advice for students" (CD & JT, p. 17). The club meets virtually, making it "like a really big class with thousands of students there" (CD & JT, p. 17). When a company contacts the UMUC faculty with a position opening for cybersecurity professionals – or any computer-related position – a notice is posted to the Computer Club virtual space so that active students may view the posting and apply for it, in addition to participating in other club activities.

Sharing What Works: Evidence of Effectiveness and Success

Challenges to gathering evidence of success. University administrators and program faculty shared that it was challenging to provide evidence of the success of the BS in Cybersecurity program at this time because the degree program was only two years old. It is too soon to have gathered much detail in evaluation reports for program review or to see evidence in terms of graduation rates and employment outcomes. What can be offered in this section are plans and strategies, as well as evidence drawn from UMUC bachelor's degree students as a whole which might provide some insights into what may be expected from BS degree students in Cybersecurity.

Evidence offered as a demonstration of success.

Applications in capstone course projects. University administrators and faculty report "putting a lot of emphasis on authentic assessment in the last couple of years … trying to simulate more of a real-life scenario where you use these skills" (CD & JT, p. 27). For example, they have developed capstone projects in courses that engage with agencies, such as the Department of Homeland Security, to develop disaster plans. Students are reported to "get really excited about these courses" (CD & JT, p. 28) and the hands-on experience that they offer.

Graduation rates. It is difficult to judge program effectiveness in terms of graduation rates for two reasons. One, the BS degree program in Cybersecurity is very new – it has only been offered for two year. Second, many students attend the program while working part-time. Therefore, even if they transfer in with an associate degree, they would typically need more than two years to graduate. Even with these limitations, a faculty member from the BS degree program in Cybersecurity reported that 42 students were on schedule to graduate from the Cybersecurity BS degree at the end of Spring 2012. There was some speculation among university administrators that some of these graduates may be individuals who had transferred over to the Cybersecurity degree from other majors (e.g. Information Assurance). Data were not available on these upcoming potential graduates at the time of our visit in March 2012.

In general, university administrators reported that, across UMUC, it is the students with associate degrees who are the ones that tend to complete bachelor's degree programs. Their understanding of the reason for this phenomenon was explained as follows:

> To complete the associate degree, [students] have gone through this academic exercise of looking at degree requirements, taking the right class, applying for graduation. So when they come to us, they know that. So they follow through on doing the same thing. (CD & JT, p. 14)

Anecdotal career and employment information. Whereas concrete employment data for their graduates may be difficult to come by, UMUC faculty and administrators of the Cybersecurity degree program hold the strong belief that "for the most part, our students, once they graduate, they should be able to find a job if they're looking for a job" (CD & JT, p. 17).

Surveys of graduates. While graduate survey data was not available specifically for graduates of the BS degree program in Cybersecurity, data was offered from the FY 2010 survey of UMUC's bachelor's degree recipients across degrees. Of the respondents, 88% of undergraduate degree recipients indicated that they would attend UMUC if they had it to do over again, while 8% responded "not sure" and 5% indicated "probably no" or "definitely no." Regarding how well they felt UMUC prepared them for their current job, 65% reported "excellent / good," 18% reported "uncertain" and 17% reported "fair / poor." The majority of graduates were employed full-time (78%) or part-time (6%), with some students unemployed but seeking employment (11%), and the remainder not seeking employment (6%). When asked the extent to which their current job was related to their field of study, 39% responded "directly

related," 33% responded "somewhat related," 11% responded "not related, not important," and 17% responded "not related and would like a job related to major." In regards to further education, the majority of students felt that UMUC prepared them well for graduate or professional study, with 82% responded "excellent/good" regarding their preparation level. 11% responded that their preparation as "fair/poor" and 7% indicated that they were "not enrolled" in graduate school. The median salary of bachelor's degree recipients was $60,972.

Descriptions of evaluation efforts.

Program review. Academic program reviews are carried out every five years at UMUC. The Cybersecurity program had not yet undergone an academic program review at the time of our visit because it was not yet five years old.

Student evaluations of individual courses and instructors. Student course evaluations are collected for each course. The response rates of these evaluations are quiet good because students get "locked out of the class" (CD & JT, p. 22) in the online format until they submit a form. This does not mean that they are required to fill out the form, but they must at least submit a blank form, and as a result, most students submit data.

Wilmington University's Bachelor of Science (BS) in Computer and Network Security

Wilmington University (WU) was first established in the late 1960s in New Castle, DE under the name of Wilmington College. The first building that was purchased for the campus had previously housed a motel. All of the college functions, from administration to classes, were held in this space. The first class of students, enrolled in 1968, began with a total of 194 students. Building upon these humble beginnings, the institution has grown into a private, non-profit university, offering an array of bachelor's, master's and doctoral degrees. The institution officially changed its name to WU in September 2007 in order to reflect the comprehensive nature of the degree programs and mission to which the institution is now committed. While the main campus remains located in New Castle, DE, the university now has eight locations throughout Delaware, four locations in New Jersey, and two locations in Maryland. The student body has grown to over 15,000 annually, drawing heavily from a population of "mostly non-traditional students who are in the workforce" (EG-MH, p. 5).

Program administrators pointed out that, while the institution has grown into a comprehensive university, it has carefully maintained its roots as "a career-driven university where most of our programs lead directly to careers" (LH-MH, p. 1). The mission of the university reflects this career orientation:

> Wilmington University is committed to excellence in teaching, relevancy of the curriculum, and individual attention to students. As an institution with admissions policies that provide access for all, it offers opportunity for higher education to students of varying ages, interests, and aspirations.
>
> The university provides a range of exemplary career-oriented undergraduate and graduate degree programs for a growing and diverse student population. It delivers these programs at locations and times convenient to students and at an affordable price. A highly qualified full-time faculty works closely with part-time faculty drawn from the workplace to ensure that the university's programs prepare students to begin or continue their career, improve their competitiveness in the job market, and engage in lifelong learning. (http://www.wilmu.edu/mission.aspx, August 29, 2012)

Descriptions of Current Students – Transfer vs. Native and Recent Shifts in Student Populations

Historically, the institution has primarily attracted "older adult students who are coming back to school after a period of time" (LH-MH, p. 1). Program administrators suggest that a variety of program characteristics contribute to this trend. For example, there are no dormitories on campus for traditional students to inhabit; all students must commute. Block scheduling, with classes meeting for a single session of up to five hours per week, is viewed as attractive to those who are balancing school and work responsibilities. Offering three full 15-week semesters each year allows students to accelerate degree completion. Summer is not a "dead time," (LH-MH, p. 9), but rather seen as an opportunity to take a full third term load of coursework in a single academic year.

The number of transfer students at WU as a whole far exceeds the national average. According to NESSE data, 89% of senior students were transfer students (EC, p. 4). The majority of transfer students bring in approximately 60 credit hours from a community college. As expressed by an institutional research analyst, they "come here to finish up what they were doing or to complete a pathway degree" (EC, p. 4).

However in recent years, there has been a shift in the student population, with more traditional-aged students enrolling in select programs at WU. Program advisors for the Computer and Network Security (CNS) degree estimate that the CNS degree program enrolls 60% older adult students and 40% traditional aged students, stating: "it's catching up quickly that we get more and more of the traditional-aged students" (LH-MH, p. 1). Several factors are believed to contribute to this change in student demographics. Most notably, program administrators point to the appeal of new programs offered by WU, particularly technology programs which are "very popular with the younger students" (LH-MH, p. 2)

The influence of the traditional student population is experienced in a variety of ways. For example, the campus is making inroads in NCAA-2A sports. Program administrators note that the institution is "fairly competitive for being a small school with no dorms" (LH-MH, p. 2), citing the first national title won in the 2012 University Cheerleading Association's College Cheerleading National Championship.

Comparison to Other Higher Education Institutions

The primary competition for WU is University of Delaware – located less than 15 miles from the main WU campus. However, WU program administrators acknowledged some of the characteristics that set it apart from its closest neighbor. On the one hand, WU offers open admissions to all who are interested, while University of Delaware is quite selective, with an acceptance rate of 59% in Fall 2012 (according to IPEDS College Navigator, nces.ed.gov/collegenavigator/). Additionally program administrators at WU distinguish between program offerings at the two institutions. For example, the security, information technology, and graphic design programs offered at WU are not found at University of Delaware, which instead offers programs in computer science and computer engineering. Program administrators argue that these programs appeal to a different groups of students. Additionally, WU is a private, non-profit institution, with all revenue from tuition going "back into the institution infrastructure (EG-MH, p. 5)

The BS in Computer and Network Security (CNS) Degree Program

The field of cybersecurity "emerged in the mid-1990s with the proliferation of the Internet," and "no standards of curriculum existed at the time the program was developed" (Program Review Draft, 2012, p 4). Some higher education institutions in the geographic region had information technology or computer science degree programs that included one or two courses that focused on computer security, yet no degree program was specifically designed to prepare students to be information security professionals.

The BS in Computer and Network Systems (CNS) degree program evolved out of a combination of old programs in the College of Technology that were struggling. One of these programs was entitled Internet and Network Design, which combined two networking courses with a series of multimedia and art courses. Student feedback from this program suggested that students wanted more technical courses in their educational experiences. Another existing degree program was Information Research Management, which "really tried to apply technology to business" (JG, p. 1). Graduates from this degree program were viewed as "generalists," and experienced challenges finding jobs because, although they were associated with business majors, they lacked depth in any of the traditional areas such as finance and management. Faculty worried that by staying at the "high-level, almost surface-level" introduction to both technology and business they were "almost mis-serving students" (JG, p. 1). Helping students develop a more in-depth technical background was seen as a way to both help students find jobs and to encourage them to come back to the WU community to continue to build the program over time.

Transitioning the program into deeper technology training began with small steps – breaking apart a computer and explaining how the inner system operates, how a database environment works, and other surface-level instruction. These changes were not enough to make their students competitive in the current workplace – "it's not helping the students gain any additional jobs or add advantage in the workplace" (JG, p. 2). So, the faculty continued to seek new directions for the degree program.

Receiving a set of seven computer security-related textbooks from an academic publisher spurred the idea to design a new program that combined existing knowledge in networking, technology, and information management content, with computer security to develop a new degree program. Several instructors who already had a security background recognized this as "an area we think we can apply ourselves" (JG, p. 2). Experienced instructors who work in industry were called upon to explore the market for this type of degree program and to determine the required curriculum. Approximately 10 courses were developed in areas such as cyber law, electronic discovery, and computer forensics, drawing heavily from the experience of practitioners.

At the time the CNS program was being developed, CyberWatch was just getting started (receiving their first NSF grant in October 2005) and was not a known entity to the WU faculty. Program administrators reflect that, if they had known about CyberWatch, the WU degree program "probably would have more closely mirrored the model curriculum, and would have been named it something other than Computer and Network Security, perhaps Information Security or Information Assurances" (EG-MH, p. 7).

One of the key hurdles of getting a new degree program approved at WU is recognizing the primary mission of the institution – "preparing students for employment" (EG-MH, p. 8) – and demonstrating to the President where students will find jobs. This was particularly challenging for a program in CNS because, 7 years ago when the program was under development, the Bureau of Labor Statistics did not have any job categories for computer security. Relying on input from practitioners in the field, program administrators argued that, "it was a risk that was a risk worth taking" (EG-MH, p. 8). The CNS degree program plan was submitted to the WU Curriculum Committee and approved in April 2005. The Faculty Senate voted to approve the new program on May 12, 2005. Now, in 2012, program administrators point to a list of employers who hire their graduates and to the recent growth in enrollment as evidence of the CNS degree program's necessity and success.

The CNS degree program is offered in a face-to-face format at both the New Castle and Dover campuses of WU. In January 2011, the face-to-face program was introduced in a 2+2 agreement with McGuire Air Force Base in New Jersey. At the time of our site visit in March 2012, of the 15 core security courses, 12 fully online course versions had been developed. Online versions of the remaining three courses were

scheduled to be complete by the end of the summer 2012, although, as will be discussed later, some faculty members expressed hesitancy regarding the transition to a fully online CNS degree program.

Program learning goals and objectives. The CNS degree program includes two primary strands of technical training. First, from a standpoint of data system protection, "students learn how to build, manage, and maintain information systems in a secure fashion such that the data can only be accessed by those authorized to do so" (Program Review Draft, 2012, p. 4). Second, from the standpoint of prosecution of intrusions and other crimes involving digital evidence, "students study investigative techniques to find data, the associated ethical issues, and the chain of custody procedures to be followed with respect to the law" (Program Review Draft, 2012, p. 4). Throughout the curriculum, emphasis is also placed on developing communication, collaboration, and critical thinking skills.

The program learning goals and objectives for the CNS degree program are outlined on the website (http://www.wilmu.edu/technology/cns_about.aspx). The program is designed to train IT professionals with a "well-rounded" education who are prepared to secure the information of whatever type of organization or employer they serve. As expressed on the website: "The General Studies core and support courses interact with the security core to deliver a 'complete package.' … In addition to becoming well-prepared for a technical career, students will also enhance their writing, verbal communications, and analytical thinking skills." Primary topics covered in the curriculum include:

- Legal aspects of data – how electronic data and documentation may be used in a court of law to satisfy the rules of evidence,
- Ethical practices associated with the role of a computer professional – copyright protection, intellectual property, user privacy, and
- History of network and computer security, examining how issues have changed with rapid advances in technology.

Program competencies for students who complete the CNS degree program are defined as:

- Apply the ethical principles required of computer professionals:
- Demonstrate technical knowledge in Information Assurance necessary to prepare for an entry level position in the Computer and Network Security field;
- Analyze requirements for Information Security projects using best practices and current methodologies;
- Deploy the process used to analyze, design, Implement, test and deliver Information Assurance projects;
- Demonstrate knowledge of best practices used to manage Computer and Network Security projects; and
- Practice the use and employ the benefit of library resources, including subscription services and other sources generally accepted as legitimate and valid.

Curriculum Design.

Academic tracks. There are two tracks available in Computer and Network Security at WU, the standard four-year degree (developed in 2006) and a completion degree (developed in 2009/2010). The four-year degree program is 120 credit hours. These courses are divided into five categories – 42 core course credits, one College of Technology elective (3 credits), 21 support core credits, 39 credits of General Studies, and 15 credits of free electives. Course sequence plans suggest that students enroll in 5 courses (15 credit hours) per academic semester. However, most students, both adult and traditional-aged, choose to work while enrolled in their studies. As a "working-student population," many students opt

to take 4 courses (12 credit hours) per semester, essentially adding an additional year on to their degree program (LH-MH, p. 10). Faculty members estimate that 60-65% of classes are offered in the evenings, which accommodates the "working-student population." The retention rates from year-to-year, or the percent of students who persist to attain the bachelor's degree, were not known by program administrators at the time of our site visits.

The completion degree is designed for transfer students who have completed an associate degree prior to entering the program at WU. The completion degree enrolls students directly into the 300- and 400-level CNS core curriculum, provided students have the appropriate pre-requisites for this coursework. Students who transfer from a well-aligned associate degree program (such as the AAS program at PGCC, which follows the CyberWatch model curriculum) can move seamlessly into the upper-division coursework and achieve a completion bachelor's degree in approximately a year and a half. Those who transfer from a less well-aligned program may need to complete up to 15 credit hours of prerequisite coursework.

Note that the articulation agreement between WU and PGCC is quite recent, completed in September 2011. No students had transferred in line with this agreement at the time of our Spring 2012 site visit. Transfer students in the current CNS completion degree track are heavily drawn from Delaware Technical and Community College.

Course sequencing. The first course that students in the CNS degree program start with is the ethical foundations course. The seriousness and care with which this requirement is attended is palpable across interviews with program administrators and adjunct faculty. As described by one adjunct faculty member:

> Everyone, regardless of where they come from, they are required to take an ethics course. We want to make sure that ethically that everybody is operating under the same frame that we are. We are here to teach some very exciting things, but we always want to do it under the umbrella of we are protecting data, we are protecting people, we are protecting the community at large. That is very, very important to us. (p. 4)

From this foundation, the technical coursework begins from learning about a single machine, and branches out to protect more and more complex systems. As one adjunct faculty member describes it "I always say go from the host, which is usually the root of all evil – one particular machine. And start to branch out, and then at the end start to protect the perimeter" (JG, p. 4). This inside-to-outside approach is not taken by all academic and training programs in the IT field. WU selected this approach because it "kind of followed the methodology of how students think about their world. They think about their own little environment at home or in their dorm, and then start to branch out from there" (JG, p. 4).

Faculty view the curriculum design and sequencing as offering a "continuity of care" (JG, p. 7) to help students stay engaged in the material and to successfully reach learning goals. Faculty attempt to make sure students are taking courses in the prescribed order because:

> There are little nuances along the way that build the story. So if you start taking [courses] out of order and you're not a really strong student then the story will not become complete to you. It will be a little disjointed later when you get to the upper level courses.

The core curriculum is developed around 11 courses – 9 or 10 of the courses are requirements, 1 or 2 of the courses are electives.

Math requirements. The highest level math courses required in the CNS degree program are College Math II and Inferential Statistics. Yet, there is some discussion of increasing the math requirements to Calculus II in the future.

Views expressed on general education courses. Little latitude is offered in the selection of general education courses for students in the CNS degree program. In particular, no substitutions (courses, transfer credit, or prior learning assessment) are accepted for the Ethics for Computer Professionals course (also known as "Ethical Hacking"). Yet, students who transfer into the CNS Complete Degree program with an associate's degree are given the benefit of the doubt that the necessary general education were included as a part of that associate's degree. Program administrators stated: "In order to make this a transfer-friendly program, … we don't nickel and dime whether they had two social sciences or two humanities." The completion degree is viewed as offering a "tremendous amount of flexibility" in general education courses as opposed to the traditional degree because they are "not really looking at those courses … we turn a blind eye towards it basically." (LH-MH 5-6). This approach to general education suggests a level of trust in the quality of curriculum offered by their partnering community colleges – an expectation that WU can assume that students with an associate degree have received a "well-rounded" education; that they "have what they need from their [associate degree-granting] institution." Still, program administrators state that, with the CNS degree program being so new, there is not "enough history to see any data to indicate that it's one way or the other; whether it's a good way to go" (LH-MH, p. 6).

Student reflections on curriculum design. Students express an appreciation for the progression of courses and topics as they are covered in the curriculum. For example, one senior student described how the introduction to computer security provided a framework that could be applied to all future classes:

> Introduction to Computer Security really helped put the strategy in focus because that's basically the crux of it – the digital liability model. What is the first tier? You might have to have senior support on the management. You must have an allotted budget. What is the second tier? Having an IT policies and procedures. Number three, the implementation. Number four, the hardware. It encapsulates everything that is necessary for you to know about computers… from the computer networking security aspect of it. So that class really set a great foundation to what I was getting myself into.

Regarding potential improvements to the curriculum, students expressed a desire for more programming experience to be embedded in the curriculum. There is an introductory Python class, and a SQL class that can be taken as an elective choice. Yet, as a group, the students who participated in focus group discussions felt that this was a weak point in their education. As one senior student expressed:

> Here's an example, one concept that we talk about in almost every class is SQL injections. And, this is great, we know that SQL injections exist, we know in theory how they work, but how many of us know SQL very well to actually be able to do some of these SQL injections? So, and that goes back to some of the more fundamental computer sciences as far as programming things that I would like to see.

Security clearances. Security clearances do not seem to be discussed in detail with students. This contrasts sharply with other sites visited in the cybersecurity field. For example, as one adjunct faculty member stated, "in both of my courses – the 300-level and 400-level – I really don't get into security clearances other than mentioning them" (JG, p. 10). The reasoning behind this lack of discussion, for this adjunct faculty member, was that he did not see many students who had a pressing need for information on security clearances. He states that, in his role as an employer:

> I really try to start everybody entry level. I don't even let them touch security for a while, even though I know that's their area. Let's start at backups. Let's start at basic operating systems and let's have them gate out of certain things and be successful and then they jump into storage, and then storage security, and then networks, and then network security. Usually it's a several year evolution. Once we get to network security, then they are doing security clearances with them. But I only had one student out of the 29 that I hired that ever got to that level.

For the site visit team, this raises questions. What types of positions are the students being prepared for? If this career trajectory is common among employers, do students know that they will not be involved in security tasks on the job for some time? How are students' options limited without a security clearance? Do students understand the security clearance process and how it impacts their opportunities in the job market (particularly locally)? What about the large numbers of international students enrolled in cybersecurity courses and the degree program? How does their nationality effect their likelihood of obtaining a security clearance, and do they know this?

Enrollment and Student Demographics

Looking specifically at the BS program in Computer and Network Security, program administrators report a perception that there are more students who are native to WU enrolled than transfer students. The ratio of native to transfer students seeking help from CNS academic advisors is estimated at approximately 50/50. However, this degree-specific advising office does not see freshmen students. Program administrators' best estimate of the overall student population in their degree program is that 35 – 40% of students are enrolled in the completion degree, with the remainder enrolled in the traditional program. According the data presented by an institutional research analyst, 66 students (22.8%) were enrolled in the Completion program during the Spring of 2012, while 224 students (77.2%) were enrolled in the regular, four-year program, for a total of 290 enrolled students in Spring 2012. The factors contributing to these discrepancies are unknown. Program administrators suggest perhaps a "stigma (associated) with going to a community college versus going to a university" or the success that WU has had in national competitions over the past three years "drawing a lot of attention" directly to the CNS program encourages earlier enrollment as first-year college students (LH-MH, p. 3-4).

Program faculty and administrators make a few distinctions between transfer students with an associate degree (those in the completion program) and native students in the CNS degree program. The only difference shared was that transfer students are perceived as "a little more engaged, more focused, early on" (JG, p. 6). They tend to have more experience and, building upon that background, can pick up concepts more quickly.

At the program's launch in 2006-2007, 134 students were enrolled in the CNS degree program. According to the draft program review document (2012), the program has experienced steady enrollment growth, increasing to 365 students at the start of the 2010-2011 academic year (p. 17). Program administrators verbally reported that total enrollment had grown to over 400 students in the 2011-2012 academic year. Even with this growth, efforts are made to keep the student to teacher ratio low in major courses. All face-to-face courses in the major require computer labs, which have a maximum seating capacity of 16 to 24 students. The average class size of the 176 face-to-face sections held between Fall 2006 and Fall 2011 was 13.3 students. Over 15% of the sections were enrolled at full seating capacity (Program review draft, 2012, p. 16). The average class size for 11 sections of online courses offered between Spring 2010 and Summer 2011 was 9.4 students. Program administrators suggested that "the average online class size is expected to grow once the entire program becomes available online and students become more aware of the offerings" (Program review draft, 2012, p. 16).

As might be expected with the growing program enrollments, the number of graduates from the CNS degree program has also increased over the past few years, as depicted in Table 14.

Table 14. Number of CNS Degree Graduates by Academic Year*

Academic Year	Number of Graduates
2008-2009	13
2009-2010	34
2010-2011	54

*Program Review Draft (2012, p. 21)

Looking at demographic characteristics of students enrolled in the CNS degree program, program administrators express concerns about the reliability of reported ethnicity data, as a large percentage of students are identified as "unspecified" or "race and ethnicity unknown" and faculty members' "classroom observations and informal discussions with students" (program review draft, 2012, p. 17) create the sense that significant minority populations are not well-represented in the quantitative data that is available. In regards to gender, program administrators reflect that "the gender gap is a well-known problem in the technology community," and that their program data between Fall 2006 and Fall 2011 "suggest that male enrollment is growing faster than female enrollment" (program review draft, 2012, p. 20). The average age of CNS degree students has remained relatively consistent between Fall 2006 and Fall 2001, falling near 29 years of age.

Faculty Roles and Positions

There is one full-time faculty member for the CNS degree program. Between Fall 2005 and Fall 2011, the program has hired 31 adjunct faculty members. The focus on adjunct faculty members making up a large majority of the instructors teaching in the classrooms fits the University's philosophy – "to use experts from the field" (EG-MH, p. 4). Regarding gender, 29 faculty are male and 3 are female. Of the 27 faculty who have disclosed their ethnicity, 25 identify as White and 2 identify as Asian or Pacific Islander. Of the 32 instructors, 20 have earned a Master's degree, 11 have earned a Bachelor's degree, and the 1 non-degreed instructor is a long-time Delaware State employee who is highly-regarded by his peers for his technical competence and has consistently received positive student feedback on his course instruction. Specifically for the Computer and Network Security courses, there are approximately 27 to 30 adjunct faculty teaching each term.

Full-time faculty at WU are not in a tenure-based system. Program administrators state that, "we just don't do that here." They stress how this contributes to the institutional culture, saying "We're obviously not in it for the money. They're teaching because they have a passion for it and they want to give back" (EG-MH, p. 5). There is a very low turnover rate with adjunct and full-time faculty in the CNS degree program – "there aren't that many who go away." However, the continuous growth of the program has created a steady need to seek new adjunct faculty to add to the group. Faculty generally teach one or two classes per semester. A few teach three classes, but they make a strong effort to avoid adjunct faculty taking on four or more classes at one time, to keep the role from becoming a second full-time job for these individuals.

Very little technical support is offered to instructors in the CNS degree program. It is expected that instructors will "have some level of competency" (JG, p. 22) to independently troubleshoot technology challenges. An exception is made in the case of web design and application instructors who may not have deep experience with hardware.

Having such a large adjunct faculty body leads to reliance on their expertise for developing courses and keeping them up-to-date. The department chair acknowledged that he was "not a content specialist on all the courses, or even most of them" (EG-MH, p. 12). Adjuncts are expected to be the "champion of a particular course" (EG-MH, p. 12). When programs are identified as needing changes or updates, program administrators contract with an adjunct faculty member to outline major course areas and develop a revised course outline. Faculty and student focus groups follow in a collaborative effort, providing opportunities to key stakeholder groups to give input on core courses. One of the adjunct faculty members also reflected on his input into course development, saying:

> I've been able to help with looking at the data and making decisions on the future of the programs that we offer. Not only in the security concentration, but also in the programs that surround that [e.g., Information Science Technology]. I have a voice in those meetings, and I value that a lot.

Approximately five adjunct faculty members are highly-involved in course and program development. Selection for this work is "usually based on [the faculty member's] ability to contribute, as well as to listen and provide feedback" (JG, p. 18).

Challenges and Areas of Concern

The primary challenge highlighted by program administrators related to infrastructure. Finding physical space for rack servers, keeping up-to-date equipment, software licenses, virtual lab equipment, and materials, and having resources for the various program offerings (e.g., media classes preferring Mac computers, security classes preferring PCs) is a constant challenge. It was expressed that:

> Currently, neither New Castle nor Dover has a real networking lab comparable to facilities of other universities or community colleges. In particular, the gap between the superior lab facilities at the [Delaware Technical and Community College] Terry campus and either of the Wilmington University's New Castle or Dover campuses is readily apparent to transfer students. These physical lab facilities need to be upgraded in the years to come to maintain the credibility of the program.

One adjunct faculty shared his perception that the necessary resources to teach effectively are available, saying that computer infrastructure is one area that program administration "invests in heavily," (JG, p. 15). While access to these resources is not necessarily an issue, this adjunct faculty member sees more of an issue with volume. It was his wish to simply "have more gear" (JG, p. 15):

> I almost want to gear up one of these classrooms so it is already set so you have firewalls at every station, you can network from the – kind of like a class you can break down and rip apart. Almost like an education class, when you have a Kindergarten class with all those materials. You want to have a plethora of all that stuff floating around. … make it a true learning environment, a network where you have cables, just make it a rip and replace kind of thing. When you apply the theory to hands on, there is nothing better in a classroom than that. I always found that my students learn the best when they had that kind of gear in front of them that they were using. I found that they valued the program that much more.

Students echoed these concerns in a student satisfaction survey that was administered to the general CNS student population (Program review draft, 2012, p. 22-23). Students indicated the need for additional hardware such as routers, firewalls, switches and servers to support hands-on learning activities, as well as a need for more physical lab space. (More information on the student satisfaction survey can be found in the Evidence of Effectiveness and Success section, later in this report.)

Program administrators expressed that, on the positive side, WU was "ahead of the curve" (Program Review Draft, 2012, p. 6) in relation to equipment available for remote lab platforms and distance learning courses. Their VMware environment is modeled after state-of-the-art courseware used at the University of Alaska-Fairbanks. It is supported by their Information Technology department, and made available to instructors of both online and face-to-face classrooms.

There are also resource challenges beyond the control and decision-making of the College of Technology. For example, the program has grown so quickly that classes have been moved to Friday nights and Saturdays, "not because we're out of classrooms, but because we're out of parking spaces."

Looking forward, program administrators would like to continue to develop cutting-edge courses and program areas, such as mobile device forensics. Yet, taking such new directions will require both (a) finding qualified faculty to teach those programs, and (b) finding materials to teach from. Textbooks are often not yet available in such cutting-edge fields, and work is required to obtain copyright permissions when course packets are developed.

Program administrators reflected that they perceived the biggest challenges for students to complete the degree program related to work-school-family balance. As described by an academic advisor who serves students in the CNS degree program:

> Time management, working school around life. Most of students have families of some sort to support, full-time jobs. So finding the hours in the week to come to class and do the assignments, I think is one of the main challenges that our students face. (LH-MH, p. 9)

These challenges are mirrored in discussions with program administrators and students from the community colleges involved in this case study.

Students discussed learning about the CNS degree program through two primary sources: networking and independent website searches. One senior student that we spoke to reflected that he was prior military who was injured during his service. Upon returning home, he found himself self-employed in a position the he did not see as long-term career solution: "I just was buying houses and turning houses out, and I looked around and, you can't do that for forever." A representative at the VA hospital told him about computer and network security and the program at WU, which sparked an interest that he has continued to pursue. Another senior described a "small networking job" that he landed in his early 20s. He enjoyed the work, and decided to pursue a college degree so that he could progress further in the area. He initially thought about pursuing a computer science degree, but then discovered computer and network security on the WU website. He reflected that he was "fascinated" with this alternative degree path.

Sharing What Works: Program Quality

National Center for Academic Excellence designation. The CNS degree program meets the outcomes-based education standards set by the National Security Telecommunications and Information System Security Instruction (NSTISSI), and is mapped to standards 4011(Information Systems Security Professionals) and 4013E (Systems Administrators). The degree program has also applied for and been designated by the National Security Agency and the Department of Homeland Security as a Center for Academic Excellence (CAE) in Information Assurance Education (IAE).

The CAE-IAE status is available to nationally or regionally accredited four-year colleges and universities who offer a degree program in information assurance or a related area. To be eligible to become a CAE-

designated institution, the institution must be certified to offer CNSS training that meets standard 4011, as well as certification for one additional CNSS training standard (4012, 4013, 4014, 4015, or 4016). The CNSS standards specify the minimum training requirements for entry level positions as information security professionals or systems administrators in the federal government and its contractors. Additional criteria for achieving the CAE-IAE designation are provided online at: http://www.nsa.gov/ia/academic_outreach/nat_cae/cae_iae_program_criteria.shtml In 2012, approximately 125 institutions, in 42 states, carried the CAE-IAE designation. WU is the only institution to be awarded the CAE designation in the state of Delaware (Program Review Draft, 2012, p. 5). This designation is valid for five academic years, after which the institution must successfully reapply to retain its CAE designation.

Program-specific accreditation. Program administrators are considering whether or not to pursue additional accreditations. One possibility is to seek ABET accreditation, yet there are some hesitations regarding this path. For example, while ABET evaluates individual programs of study, it does not have an accreditation program area for cybersecurity programs. Rather, the ABET accreditation would be in a more general category of Information Technology (EG-MH, p. 3). Another possibility would be to seek an ATMAE accreditation from the Association of Technology, Management, and Applied Engineering (ATMAE), which offers individual program accreditation for applied technology programs – a focus which is evident in ATMAE's mission statement which expresses dedication to "solving complex technological problems and developing the competitive technologist and applied engineering workforce" (http://atmae.org/index.php?option=com_content&view=article&id=1&Itemid=2). There is some consensus by program administrators that this applied focus may be a better fit for WU, in comparison to the accreditation offered by ABET.

NSF-ATE centers. One of the discussions that caught our attention was the description of the relationship between WU's CNS degree program and the CyberWatch Center. CNS degree program administrators described CyberWatch as a "great learning community" that provided the foundation and impetus for the development of the CNS bachelor's degree program at WU. These comments were particularly intriguing to our research team in contrast to the focus that we observed CyberWatch placing on the development of associate degree programs (e.g., promoting the model AAS degree curriculum), as opposed to bachelor's degree programs. Yet, WU provided a lens through which to see the influence that NSF-ATE funding and resources could have, although originally focused on the community college, on the creation of applied baccalaureate degree pathways that are housed in four-year degree-granting institutions.

The following quote from an administrator in the CNS degree program at WU describes their relationship with the CyberWatch organization and team, as it has developed over time:

> I went [to a professional conference] and who's presenting, but Dr. Zdravkovich and Bob Spear. That's how I learned about CyberWatch. And I found out, well, it's free. So I attended a couple of meetings. I found out about the Colloquium of Information Security Educators. I'm now on the board for that organization. I was the program chair for last year's conference. I found out about the DC3 competition. I found out about the National Collegiate Cyber Defense competition. I found out about the Center for Academic Excellence. And really, just the effort of applying for that really taught me a lot about what I should be doing as an academic. You know, sharing. Like this meeting here. That's why, you know, I said, "Yes, I have the time. Come on over; we'll talk to you." It's part of walking the walk. So that all came from the relationship with CyberWatch.

This catalytic nature of CyberWatch – welcoming new members, building communities, sharing information and resources – is heard in different ways at the different higher education institutions that we visited. At WU, the relationships developed with CyberWatch members served to inform program development in the CNS degree program, and then further enhanced program offerings by providing

access opportunities and resources. For example, WU students have participated in the cyber competitions that allow students to showcase their skills and provide marketing opportunities for the University. Additionally, through the CyberWatch networks, WU has had the opportunity to borrow resources from an online teaching environment at the University of Alaska, giving them access to $40,000 - $50,000 worth of hardware that would otherwise be out of reach.

Industry advisors. Program administrators rely heavily on their advisory committee and industry contacts to ensure that relevant, accurate, current, and necessary topics are taught in the CNS degree programs. "Employers tell us anymore that it's okay to know the theory, but [they also want to be able to put [students and graduates] to work when they arrive" (EG-MH, p. 15). For example, industry advisors stressed the importance of balancing the ability to apply technical expertise with report writing, communication, and other soft skills. Here is an example, given by CNS degree program administrators, drawing from the forensics field:

> If you're doing forensics, [you must have] the ability to write the report and track what you've done so that it can be duplicated and replicated. Also, if it goes to court, whether civil or criminal, you have to have that paper trail to show exactly what you did to preserve the hard drive, the thumb drive, whatever it was, and how you did your replications for your working copy, and what tools you used in the process. [You need] the ability to do that orally as well as in writing. (EG-MH, p. 9)

As a result, WU's forensics courses are designed with a two-pronged approach: protection (firewalls, security, etc.) and prosecution (legal studies, electronic discover, cyber law). An employer and adjunct faculty member stressed the importance of customer service skills in his new hires – regardless of the position they are hired for:

> I try to bring everybody in to the customer service environment first. I think it is probably the most important environment. Even somebody who is making $150,000 a year in another location, working in another business unit, finance or whatever it is. I want them to start at that level, because I think there is a level of empathy you need to develop for customers and issues. I think you become a better technical person, a better executive by working the phones. … actually work with customers and try to figure out what's working, what's not working. How do I personally make an impact and make a difference in the way in which we are running operations? And, I really want every student and every employee to think that way. (JG, p. 23)

Partnerships with higher education institutions: Assessing program quality and challenging each other. Program administrators shared intriguing insights regarding their relationships with community colleges. They reflected on how WU's career focus and hands-on learning approach are mirrored in the community colleges that they partner with. In fact, these community colleges were viewed as managing a "dual challenge – to make their graduates job-ready and also transfer-ready into a 4-year program." In order to meet this challenge, the 200-level courses at the community colleges are pushing into more and more specialized and advanced material, which at times overlaps with the 300- and 400-level coursework at WU. Program administrators at WU reflected that it is a "continual challenge" to work with community colleges on curriculum offerings to ensure they will "leave something for us to teach" (LH-MH, p. 5). In fact, two 300-level networking courses at WU were dropped down to the 200-level in order to create a more seamless transfers for community college students. Constant curriculum review is needed to keep up with these inter-institutional relationships, as well as workforce demands. As described by a program administrator: "What was higher-end and high-tech, a year from now it isn't. So you go from 300 to 200 because the technology is changing, and now what is 300 and 400, you've got to be right on the edge and keep close contact with the industry" (EG-MH, p. 15).

The community colleges with whom they have strong articulation relationships are quite well-regarded by WU. For example, program administrators reflected on a "good working relationship and partnership" with Delaware Technical Community College (DTCC), even reflecting that DTCC "raised the bar for us from a hands-on standpoint" regarding the quality of training laboratories (EG-MH, p. 10). An adjunct faculty member at WU describes Delaware Tech as "very much hands-on hardware and networking" (JG, p. 6). Students who then transfer to WU have a chance to experience "a good bridge of the technical as well as the theory" (JG, p. 6), which is a balance that differentiates the WU CNS degree program.

A "very thorough vetting process" (EG-MH, p. 11) is used to negotiate new articulation agreements. Department Chairs, with input from their faculty, serve as the key contacts and decision makers throughout the process. Chairs review articulations course by course, seek input from faculty, work with articulation coordinators, and make recommendations to the Dean. The biggest challenge with articulations is that there are many different varieties of a single program – sometimes, with different varieties found on different campuses of the same community college system. "They all go to their own drummer." Every degree program that articulates with CNS must be reviewed and vetted on its own.

Sharing What Works: Educational Significance

Economic and employment needs. As with other institutions visited as a part of the CyberWatch case, CNS degree program stakeholders were quick to recognize the economic opportunities for well-trained cybersecurity workers. For example, several current students expressed that their interest in the CNS program at WU was related to what they saw as growth areas in the economic marketplace. They expected that the knowledge gained, particularly with the specialized focus in computer security (rather than a broad, theoretical computer science degree) would lead them to "so many different avenues" (SFG, p. 4) for job opportunities. Some students were able to articulate specific career pathways. For example, one senior student mentioned:

> I'm looking to try to go oversees and work ... There's a lot of programs for military and ex-military. Like maybe Dubai. There are government contractor jobs. It's tax free, and they pay good. A couple of things I looked at already were starting out at like $90,000 and then they give you housing and allowance and all that. They fly you home for major holidays. A lot of things. And, you learn. The stuff you learn over there you can bring back. You already have experience. (SFG, p. 4-5)

Other students, however, did not have such clear career directions, and demonstrated room for growth in career exploration and decision-making. Questions about career aspirations were met with vague responses such as: "I'd like to work with the FBI or CIA, local law enforcement, something like that. ... where ever I can find employment, really" (SFG, p. 4). Even when career goals or employers remained vague, students did not exhibit anxiety or concern about future opportunities. Rather, they exhibited a sense of trust that "the classes are pretty great in that they push you into the right direction of becoming a security professional" and, if they "put in your own time to solidify yourself in the field… to hone your skills," the career opportunities would emerge (SFG, p. 8).

Academic and learning needs. The CNS program design has also adapted over time to meet the perceived needs of students. For example, a new web applications certificate program was developed based on recognition of areas in which students struggled during cybersecurity competitions. Five classes are included in this certificate, covering topics such as web design, database fundamentals, and three levels of increasingly complex courses in web applications development. All of these classes are outside of the core curriculum for the CNS major, but can be taken as a set to fulfill the required 15 credit hours of technical electives. This offers students the opportunity to develop an additional set of specialized skills.

Furthermore, the Completion Degree track in the CNS major is quite new (developed in 2009/2010), and was designed to welcome all interested learners who had achieved an associates degree, whether or not that degree was related to information technology. One academic advisor for the CNS degree program describes this aspect of the program as follows:

> The beauty of the completion degree is that students can change their major from the associate to the bachelor's... As long as they take the prerequisites, then they'll be well-prepared… Under the old true articulation where we had individual agreements with individual schools, they did have to come from a very related degree in order to be eligible for our second half, for our plus-two. But now, with the completion degree, we've kind of thrown that open and added the prerequisites in there, so any students from any degree can come into Computer and Network Security. (LH-MH, p. 5)

The completion degree track, therefore, facilitates access to opportunities for those who are seeking new career directions. Those who completed an associate degree with a business major and are now looking to get involved in information technology are the most common career changers for incoming students.

Engaging students at various skill levels. Being an open access institution and welcoming a wide variety of learners to the CNS degree program also leads to the challenge of working with "a wide range of skills in the classes" (LH-MH, p. 15), from those who are "trying to find something new" and know little about technology, to those who have been working in technology fields for 10 years and know more than the instructor on a particular topic. One faculty member described his strategy for balancing this variety as "leveraging the students" in the room: "So if a student knows more about a particular subject than I do, I ask them to share and if I tried not to, then sooner or later I'd be discovered anyway. What's the point? ... Embrace it" (LH-MH, p. 8). This provides opportunities to engage students at various skill levels. A second faculty member, this time an adjunct, acknowledged that a team approach to working with students of varying ability levels helped students with higher base-skill levels to explore the "little nuances that students miss in the program" the first time that they see the materials (JG, p. 6). Furthermore, faculty suggest that many students who come into the program thinking they have a strong background were "not taught correctly" (JG, p. 6). Stepping through exercises with the full class helps "fill in the gaps for the people who think they have those experiences," (JG, p. 6) but would benefit from revisiting important principles.

Applied and hands-on learning. Faculty members at WU make an effort to strike a balance between lecture and tactical, hands-on activities in the classroom. One adjunct faculty member shared a strategy of demonstrating real-world challenges in the classroom, and then showing students the strategies and techniques to address those challenges. He provided the following as an example:

> I was just teaching this to my crypto class to paint a picture – crypto is very hard to think about how you crack security, especially when you are talking about how to crack very intense algorithms. ...
>
> I said have you ever been exposed to a security hack? Have you seen one in play? They said "well, no." In an operating systems class, here's what they would teach you. So we hit the shift key five times, and it brought up a sticky keys message and we said okay what do you want to do. This is a great way to understand how the system interoperates with the operating system-level account.
>
> Now what we want to do is restart the machine – go into F8 and start with a command line, and let's replace that sticky keys dialog box that comes up. Let's figure out what that is and let's replace it … once we reboot, hit your shift key five times again at your login screen. Never log in and you'll see a command prompt pop up. Now type in explore, now you'll see the front end of windows come in front of the login screen. Now try to set user names and passwords, and do those kinds of things.

> That's what security is about. Now you see a hack in motion and you are like okay, how do you protect against that? Well, you don't allow these systems level commands, disable sticky keys. Lock the envelope down. (JG, p. 2)

Online and web-based instruction. The CNS curriculum is primarily provided in face-to-face classrooms at this time, although there have been efforts to create hybrid learning opportunities and to create online course opportunities for students. For the technical courses, students generally express a preference for face-to-face classroom learning experiences so that they can see the equipment and receive personal, hands-on assistance with trouble shooting tasks. For example, one student shared in a focus group that:

> I took one [technical course] online and dropped it. Because for me, it's being in the class, I think that you just learn more, especially with computers because you don't have the face-to-face time to say when you are stuck. Then it is like calling into a help desk to like, what do I do now? The certain, I mean it's like the principles and all that like stuff… it's fine if you can do it. But, for a person who hasn't had the experience with computers, I fully don't think online is really the way to go. It's not helpful. (SFG, p. 6)

A second student shared this sentiment, stating that while some classes might be okay to take an online environment, programming courses did not fall into that category for him: "Certain classes like computer ethics, I'd say you can take that online. But … I took programming in Python online. I really wish I had taken that in class" (SFG, p. 6). Both of these students were males who had some military or work experience prior to attending WU; they were in their late 20s or early 30s, older than traditional-aged (18 – 24) college students. Program administrators have the overall impression that non-traditional students and career changers seem particularly interested in face-to-face instruction, while traditional-aged students appear more open to and comfortable with online instruction.

Within face-to-face classrooms, the use of web-based instruction is left to the instructors' discretion. Courses integrate hybrid online components "to the degree that the instructor includes it" (LH-MH, p. 3). Yet, it is also important to acknowledge current efforts to transition all CNS courses to be available in an online format. At the time of our visit, there were between 3 classes for which online formats had not yet been developed. A goal was set have these prepared by the end of Summer 2012. Program administrators suggest that students could then choose to complete the entire degree online. However, this sentiment was not reflected on the programs' web page at the time of our site visit and data analyses. As of August 2012, the website states that the only format the program is offered in is "traditional classroom" (http://www.wilmu.edu/technology/cns.aspx).

Program administrators expressed continued challenges with transitioning to an online curriculum. For example, online courses were viewed as "less agile" (EG-MH, p. 16) than courses face-to-face courses. If an instructor wanted to change a textbook in a face-to-face class, the change could be made quite quickly. Yet, requests for changes to online courses had to be "put in the cue for redevelopment" (EG-MH, p. 16). The University developed online courses on a semester basis and owned the templates for those course materials. Additionally, there were tasks and skills that were more difficult for students to demonstrate in an online environment. For example, demonstrating communication and soft skills. One faculty member expressed: "How do students do presentations in front of a group? I haven't heard of a good solution for that yet in the online environment" (EG-MH, p. 16). Furthermore, one adjunct faculty member reflected on challenges with translating some of the required hands-on learning into a virtual environment:

> A lot of it is face to face, you need to understand how do you build a router … you have to start by making the physical associations. Then, once they know that you can say okay, now you can go and do distance learning. Now that you have those pieces, when I expose you to these two networks that are virtual, tell me how you tie them together.

In response to concerns such as these, the CNS program was considering the addition of capstone component that would include a residency requirement. In the future, as the online offerings grow, students would still be required to come to the campus for a capstone learning experience and demonstration of skills.

Prior learning assessment. A process for prior learning assessments (PLA) is in place for students who have previously developed skills that are taught in a particular course. This option is viewed as particularly important in Information Technology, where people may have learned skills on the job and are now returning to get a degree. What value would the degree add to individuals' knowledge and skill sets? Prior learning can be demonstrated by a project or a portfolio, and WU allows up to five classes to be covered in this manner. However, there are clear limitations on this type of credit. For example, WU has a minimum residency of 45 credits that cannot include PLA credits; students must be "in a seat or at a computer for 15 courses" (LH-MH, p. 7) to receive a WU degree. However, students who demonstrate competency in a particular required course may make substitutions. Program administrators reflect that courses substitutions "do more for [students'] education" (LH-MH, p. 7) by pushing them to master new material, rather than being bored by revisiting familiar material.

Accommodations for English Language Learners (ELL). Faculty members also acknowledge a considerable number of international students and English Language Learners in classes affiliated with the CNS degree program. One faculty member described students from oversees as "very, very bright in fixing complex problems" (JG, p. 8), although they may struggle in classroom interactions due to language barriers and seem like they do not understand the material. It is, therefore, seen as important to "be dialed into" this issue, and to provide "appropriate amounts of time to be successful" (JG, p. 9), such as providing untimed tests.

Condensed course schedules. Program administrators suggested that block scheduling of classes (e.g., 7 week classes that meet 5 hours per week) was viewed as a benefit and a draw for non-traditional students who do not live on campus and who were balancing work, family, and school responsibilities. Students, however, expressed a sense of feeling torn about such a condensed approach to course scheduling. On the one hand, students agreed that "everybody likes to get done early" (SFG, p. 9). Yet, on the other hand, they saw that this scheduling compacted their learning opportunities, making it difficult to cover and deeply understand all of the necessary material. As one student described:

> To tell you the truth, the block classes feel like a cybersecurity boot camp for a four-year curriculum... I also went to Cybersecurity boot camp last year (a two week intensive session) and it was just cram information, just as much information as you can get, and that's how I feel that the block classes are. Which is great being exposed to all of that information, however, when you go home, as I was saying earlier, you do have to be doing it in your own way." (SFG, p. 10)

Maintaining stamina and energy three semesters per year, for four to five years, is a challenge for students.

Internships. Internships are viewed as an excellent opportunity for hands-on learning – "you learn a tremendous amount of things" (JG, p. 22). And yet, the faculty experience a tension with creating an internships requirement. As one adjunct faculty member explains: "If it were up to me, I would build that into our program. I would force at some level, internships. But it's tough. I'm not here to take money out of students' pockets at worksites. We play this tough game." (JG, p. 23). There is, however, evidence

that some students benefit from a direct push from faculty to gain hands-on experience from internship opportunities. For example, one senior student reflects on his first internship, the role that the faculty played, and the value that it added to his educational experience:

> A professor of mine here at Wilmington University just told me it was time. I was, you know, a little apprehensive. Especially when I know some theory of how computers work and how networking works, and what security is. But, never really had to do it. What am I going to do? … I had to get my feet wet. And take a look at the corporate world and figure out what's my position. What do we do? How do we add value to the company in some way? (SFG, p. 3-4).

Pedagogy as an area for improvement. An area for improvement mentioned by an adjunct faculty member relates to adjunct faculty participation in group reflection on teaching and instructional pedagogy – "I think as a larger group it would be great for us to mind-share a little bit more" (JG, p. 15). There are seminars and faculty workshops held through the College of Technology, yet adjunct faculty attendance is "terribly poor" (JG, p. 15).

Supports provided to help students achieve positive results and outcomes.

Dedicated faculty. The enthusiasm and dedication of adjunct faculty members was highlighted as a contributor to the success of the CNS degree program. As expressed by one adjunct faculty member:

> The reason why the program has been successful is that we have a lot of dedicated people who are genuinely interested in growing students and that is what this is about. As you all understand education, its certainly not about money or anything like that. It's really about, either you love students and you love teaching or you shouldn't be in this space. (JG, p. 24)

Students who were currently enrolled in the program echo this sentiment during our focus group discussions. They unanimously agreed that faculty in the CNS program were "dedicated" and "here for us" (SFG, p. 10) They reflected that faculty members were generally available outside of the classroom, adept at helping students work through course materials, and interacted with students in beneficial ways.

Hands-on academic advising. Departmental academic advising is handled in a very hands-on fashion, with attention given to meeting student needs and getting students in to the right classes. A program faculty member illustrated this commitment with the following scenario:

> We recently had, for instance, a student come from another 2-year college. We did not have a formal agreement with them, but they had in the course descriptions that the student had taken two Linux classes. When she was in our Linux class, she was lost. I was here that night when the instructor brought her in and we sat down and we worked with Registration to get her back into another area to start to remediate it and then bring her back up. She technically had the credits, but was lost. So we worked with her, even though it was past drop/add. We got her a refund, got her enrolled in another class, and started building again. (EG-MH, p. 10)

Despite the availability of academic advisors, course sequence guides, and an electronic degree audit system, there remains a concern among program administrators regarding students choosing to "self-advise." Students who chose to self-advise often do not select the right courses in sequence and can "get off-cycle" regarding the semesters in which courses are offered. As a result, the students' degree progress and graduation can be delayed.

Financial assistance. Tuition is charged per credit hour, with the 2011-2012 tuition and fees costs at $314.00 per credit hour on the main campus in New Castle, DE. There is no tuition difference for out-of-state students. Program administrators stressed institutional efforts to keep tuition affordable (under

$10,000 per year), and pointed to being a private school and not relying on fluctuations in government funding as a primary contributor to avoiding significant cost inflation each year. Additionally, having instruction provided by a faculty body that is made up of 90% adjuncts keeps costs and tuition low.

Keeping costs low is an important goal, as financial support structures for students rely heavily upon federal sources. Few in-house scholarships exist, and those that are available offer minimal support – $1,000 which "covers one class and maybe the books." Additionally, program administrators have recognized that employer reimbursement of educational expenditures has declined in the economic downturn. However, a large percentage of WU students receive federal financial aid each year making the recent changes to the Pell Grants "a concern" (LH-MH, p. 11) that the institution has yet to address.

Other support services: Practice labs, career center, and tutoring services. Supports and resources are also available across the campus to encourage students' academic and career success. Students have a "honey pot" (JG, p. 21) available to them that includes a small set of computers and routing equipment to use for practice during business and class hours. Additionally, the campus career center is located in a nearby building, and a student success center offers "free tutoring in math and English on a drop-in basis." Furthermore, students have access to an online tutoring program that offers math and writing support. However, program administrators perceive that the limited availability of peer tutors ("we don't have a wide variety or abundance of students who are peer tutors"), particularly those that specialize in Information Technology major classes, as a challenge and an area to address in the future.

Sharing What Works: Evidence of Effectiveness and Success

Challenges to gathering evidence of success. Beyond success in well-defined activities such as the cybersecurity competitions, program administrators reflect that it is "hard to look at the data to see [changes]" (LH-MH, p. 4) over time because the CNS degree program was only 6 years old at the time of our site visit in March 2012. The CNS Completion Degree was even newer – only 3 years old. They argue that more time is needed to gather and consider data on the larger impact of the program. In the meantime, program administrators point to defined program competencies (see section on Program Learning Goals and Objectives above) for evidence of the skills and knowledge that their program graduates should be able to demonstrate.

Evidence offered as a demonstration of success.

Industry certifications. The program website states that CNS graduates can take coursework that qualifies them to sit for industry recognized certifications, including: Certified Information System Auditor (CISA), Certified Information Systems Security Professional (CISSP), Security+, and CompTIA Network+. Yet, in regards to students sitting for the exam and passing it, the university does not "make any claim to that. We don't have any data for that." (LH-MH, p. 15). They only provide students with a certificate demonstrating course completion. The certificates offered are aligned with the 4011 and 4014 industry specifications. Offering these two certificates is one of the qualification measures that contributes to WU's status as a Center for Academic Excellence (see earlier discussion on "Program Quality").

Course outcomes assessment. Program competencies specific to the CNS degree program are measured through selected assignments and exams in selected courses (see Table 15). The draft 2012 CNS degree program review document shared with our site visit team included outcomes data collected for the six program competencies across the seven planned courses. Table 16 shows that there is quite a bit of variation regarding the amount of outcomes data that has been collected from one program competency to another, ranging from data collected from a single course section with 13 participating students, to data collected in 8 course sections over 6 academic terms from 115 participating students.

Table 15. CNS Degree Program Competencies and Course Map*

No	Program Competency	Course	Evaluation Method
C1	Apply the ethical principles required of computer professionals.	PHI314 (Ethics for Computer Professionals)	Homework assignment – Paper and rubric
C2	Demonstrate the technical knowledge in Information Assurance necessary to prepare for an entry level position in the Computer and Network Security field.	SEC410 (Web and Data Security)	Exam
C3	Analyze requirements for Information Security projects using best practices and current methodologies.	SEC210 (Principles and Practice of Information Security)	Homework assignment – Paper and rubric
C4	Employ the process used to analyze, design, implement, test and deliver Information Assurance projects.	SEC330 (Operating System and Computer Systems Security) & SEC420 (Data Integrity and Disaster Recovery)	Exam & Exam
C5	Demonstrate knowledge of best practices used to manage Computer and Network Security projects.	SEC450 (Protecting Your Network: Firewall and Perimeter Security)	Homework assignment – Paper and rubric
C6	Practice to use and employ the benefit of library resources, including subscription services and other resources generally accepted as legitimate and valid.	CRJ101	Research paper – Information literacy rubric

*Program Review Draft (2012, p. 25)

Table 16. Summary of Program Competency Outcomes Data Collection and Analysis*

Course	Competency Number	Academic Terms	Number of Sections	Number of Students	Avg Students per Section	Interpretations of Data
PHI314	C1	Fall 2008 Summer 2009 Fall 2009 Summer 2010 Fall 2010 Summer 2011 (x3)	8	115	14.4	Aggregate mean score for each of 6 criteria on rubric was well above the target threshold (4.0, on a scale of 1.0 to 7.0). No changes were needed in the course.
SEC410	C2	Summer 2009 Summer 2010 Fall 2010 (x2)	4	50	12.5	Aggregate average score of the four sections is 83.6% on the exam with a maximum of score of 100%. This is above the target threshold of 80%. No action was required in this course.
SEC210	C3	Summer 2010 (x2) Fall 2010 (x2) Spring 2011 (x2) Summer 2011 (x3) Fall 2011	10	(missing)	(unable to determine)	Difficulty experienced with the outcomes measurements and the ability of instructor's to accurately assess student's performance. Recommend revising the assessment process and tools.
SEC330	C4	Fall 2010 (x2)	2	30	15	Aggregate average exam scores fall above the target 80% threshold indicating adequate results, and no action required in this course.
SEC420	C4	Fall 2009 Fall 2010 Spring 2011 (x2) Fall 2010	5	64	12.8	The aggregate average of the midterm and final exam grades for students is above the 80% threshold. No action is required.
SEC450	C5	Summer 2011	1	13	13	All students scored well above the target threshold (4.0, on a scale of 1.0 to 7.0). No changes were needed in the course.
CRJ101	C6					No assessment completed due to determination that the originally planned assessment did not meet the data collection needs. A revised outcomes assessment plan is in development.

*Program Review Draft (2012, p. 25)

In all cases where data were judged to be sufficient for analyses, minimal thresholds were met to judge a course successful in meeting its pre-determined program competency goals and, therefore, "no action [was] required" (Program Review Draft, 2012, p. 11) for course improvement. In two courses, improvements were called for in regards to the assessment process. Of particular concern to program administrators was the use of lower level course to collect summative data about program outcomes. They expressed that "rather than assessing student learning over the duration of the program, some competencies are being measured based on what is taught in a particular course which tends to be more formative than summative" (Program Review Draft, 2012, p. 12). Looking forward, program administrators aim to focus assessment efforts in 400-level courses to capture "truly summative data." For example, rather than assessing Program Competency 6 (using library resources) in the freshman-level CRJ101 course that is managed by a College other than the College of Technology, there is discussion of moving this assessment to a 400-level course within the CNS major. Program administrators also expressed plans to develop new rubrics to accurately assess program competencies and to enhance instructor training in order to minimize subjectivity in rubric scoring (Program Review Draft, 2012).

Success in regional and national competitions. Program administrators point to their students' success in national cybersecurity competitions as evidence of outcomes. For example, teams from WU won in the undergraduate category of the Department of Defense Cyber Crime Center (DC3) Digital Forensic Challenge competitions in 2009 and 2010 (http://www.dc3.mil/challenge/). The 2012 draft CNS program review document described these achievements as follows:

> 2009: Of 1153 teams from 56 countries, the WU team finished with the third highest overall score in the world. In addition to defeating every undergraduate team, the WU team beat every government and military team that competed and finished second in the nation to a graduate team from the Air Force Institute of Technology.
>
> 2010: Of the 1040 teams from 60 countries competing, "Team Name," as they were called, similarly defeated every military and government team to complete, finishing with the fifth highest overall score worldwide. Oddly enough, none of the students were on the job market. One already had a good job in IT and the other three were focused on completing their degrees. (p. 12)

In 2011, a team also achieved the status of a Virtual Qualifying Round Winning Team in the Mid-Atlantic Cyber Defense Competition (http://www.midatlanticccdc.org/CCDC/about/ccdc-2011/). WU teams have also been active in the U.S. Cyber Challenge (https://www.nbise.org/uscc/) for several years. These competitions provide opportunities for students to test and showcase their skills, as well as serve as recruiting tools to "get a buzz going" and attract additional students to the CNS degree program. They offer WU an opportunity to "get our voice our there" (JG, p. 19), to get people interested in and excited about joining the program. They have been identified as not only attracting additional students to the program, but also in helping program administrators identify highly qualified adjunct instructors as "cybersecurity practitioners have come to know and respect the program and want to be a part of it" (program review draft, 2012, p. 14).

Career and employment anecdotal evidence. Graduates of the CNS degree programs find position in forensics, networking and administration, and security policy fields. Students who were part of successful competition teams have been hired as a Senior Digital Forensics Specialists by General Dynamics Corporation to work at the Department of Defense Cyber Crime Center (DC3), a Systems Engineer by Computer Systems Engineering to work at the Aberdeen Proving Ground in Maryland, a Network Penetration Tester for a small firm in Newark, DE, a Network Intrusion Analyst for Computer Sciences Corporation in Newark, DE, an IT Staff member for the Delaware State Police, and a Help Desk Support member for Hostings.com. Additional examples of employers who hire WU bachelor's degree graduates

from the CNS programs include Bank of America, CitiBank, Comcast, ING Direct, JP Morgan Chase, the National Security Administration, the Smyrna School District, and a number of military organizations (e.g., Air Force, Air National Guard, Army, Army National Guard, Network Warfare Squadron). Anecdotally, program administrators report that few students choose to leave the State of Delaware when considering employment options.

The City of Wilmington used to be a banking city – "every bank around was incorporated in Delaware" (JG, p. 12) – and cybersecurity professionals were needed to support that industry. Yet, when the financial markets started to fall into the recent recession, banking companies downsized. According to one adjunct faculty member, "Bank of America pulled 700,000 jobs" (JG, p. 12). In general, "job placement has been a little bit tough across all industries" (JG, p. 12). Yet, the majority of students in the CNS degree are reported to have found employment quickly.

One primary source of employment is the adjunct faculty members. As one describes: "I try to take the very best" or he "tries to get the best and the brightest" (JG, p. 13). Students are recruited for positions right out of the classroom. One adjunct professor describes that the willingness to hire students should be a requirement for those who take on adjunct faculty roles.

> I almost think that one of the gates for being an adjunct should be that you are willing to bring that to the table. It's almost like hiring a sales person. If you are out in the industry and hiring a sales person, you hire a salesperson not only for their abilities but for their book of business contacts and what they can bring to your university. … I think that anybody in this field could teach, but if you want to hire somebody, hire somebody who is going to help you create jobs.

The same adjunct faculty member and employer shared information on starting salaries and promotion opportunities for graduates of the CNS degree program. For students who graduate with the BS degree in CNS and are entering the workforce without additional experience, the starting salaries at his organization ranged from $35,000 to $40,000. Those students who have years of experience in another field or advanced skills in another area (e.g., finance, customer service) can earn as much as $45,000 to $50,000 as a base salary. This adjunct faculty member / employer also told a story of a graduate with a strong work ethic and smart mind who worked his way up to earning a $100,000 annual salary. He reflected further that:

> It just goes to show you, with the right work ethic and all these things you can really advance financially, and you can advance your career and skill set. He's doing very, very well... He's got a great career in front of him. And, he made it himself. He did all the right things, he worked hard, he learned a lot. He took every opportunity we gave him and excelled. (JG, p. 11-12).

Many other "good technical people" coming out of the WU program, "live in the middle as well, at $50,000, $60,000, $70,000 as they specialize" (JG, p. 12).

Student reflections in focus groups. Students provided anecdotal evidence of learning outcomes during the student focus groups as well. For example, one student described his experience in an electronic data discovery course in which he learned that information remains on a computer's hard drive (or a thumb drive) even after the typical user may think that it has been lost. He laughed, describing how he applied this knowledge in his own home environment – "after that I was able to get back a lot of data that I had lost for a long time!" Another student described his experience in a job interview that highlighted for him the quality of CNS degree program. He stated:

> I went to a job interview at [Large University]. That was about an IT specialist position. Honestly, during the interview, all the questions they were asking me, I knew it before, thanks to all the stuff

> I've been doing here, member of the cybersecurity group, and all the competition we've done here, and all the courses. Really it was pretty much easy. …
>
> When I was talking about Wilmington University, they were like "oh, where is that?" I was like "in Delaware." … They wanted to know much more about the program. I showed them the curriculum and they were really impressed, because here they are trying to give you the necessary stuff you need only. … Everything is specific. It is really important. (SFG, p. 7-8)

Enrollment numbers. One adjunct faculty member commented on evidence of need for the CNS degree program and the employment skills taught within the program, basing that evidence on course enrollment numbers. He stated that, "I usually have 20 in every class and that's the maximum. … so it tells us that there are still companies and individuals that are interested in the program, and we are doing some of the right things" (JG, p. 17).

Descriptions of Evaluation Efforts.

College and university-wide assessment efforts. Outcomes data based on rubric evaluations in courses are collected and analyzed for the College of Technology each semester. Data goes back several years, so it is possible to run comparisons over time. However, these data are not broken down by a single academic program; they are only reported college-wide. These outcomes data are used within a yearly outcomes summit for college deans that is held each summer. Within the summit, conversations are held regarding performance outcomes progress and desired changes to pursue as colleges move forward.

A university-wide alumni survey was just started at WU the 2011-2012 academic year, conducted by the Institutional Research (IR) office. The survey, which will be able to be disaggregated by degree program, asked questions such as:

- Did you find gainful employment? How strongly related is your current position to what you studied?
- Did you continue on to another school? Was it in a field related to your study at Wilmington?
- How well prepared do you feel you were? (EC, p. 1).

While this data analysis was not ready to share at the time of our visit, it is a resource that we may like to revisit in the future.

The university's IR office also tried a new non-returning student survey to get a sense of the barriers that were getting in the way of degree completion. The initial response rate to their survey was quite poor – only one was returned. Yet, a follow up telephone survey yielded better response rates. Findings showed that weaknesses at the college was not the reason that students chose not to return. Rather, it was personal and family issues, as well as monetary concerns, that influenced student decisions. One institutional research analyst further explained:

> Especially in 2008, with economic crisis, we saw a drop off in the number of students who returned to us. It was because they weren't sure that financial aid was going to come through. In the next term we saw an influx of students. Once they were sure financial aid was coming, that's when they came back to us.

Program Review. Formal program reviews are conducted for individual programs every 5 years. However, the requirements for certification and accreditation often call for an intermediate review every 2 or 3 years. It is helpful, because, in cutting-edge technology fields, "our [curriculum] changes every 6 months, every semester sometimes" (EG-MH, p. 2). Due to the novelty of the CNS degree program, the first program review documents for the program were being drafted during the time of our site visit in March 2012.

Student evaluation of individual courses and instructors. Students are provided the opportunity to review their instructors at the end of each course, using the IDEA Student Ratings of Instruction system (http://www.theideacenter.org/services/student-ratings), which provides feedback to individual instructors, as well as normative data from similar institutions across the U.S. If an instructor scores poorly on the IDEA for a particular course, the full-time faculty offer support, discussing potential reasons for the low scores and strategizing steps to improve in the next term. One program faculty member stated that taking time with students and being responsive to their inquiries in a timely fashion has made the most difference in their scores. He stated that:

> If you're available to the students outside the course hours, it makes a world of difference on how the scores show up on the sheet, which doesn't have anything to do with topics covered in the course. You could cover it in the exact same way, but if you make that extra time, your scores are going to go up.

Student satisfaction surveys. In preparation for the 2012 CNS degree program review, a satisfaction survey was administered to the general CNS student population (Program review draft, 2012, p. 22-23). Of the approximately 366 students surveyed, 42 (11.5%) responded. Results were included in the draft program review document (2012). In general, student responses indicated satisfaction with the degree program. For example, "Good" and "Very Good" ratings were reported by the majority of students on items related to perceptions of program quality, such as:

- Quality of instruction 91% of students
- Quality of curriculum 91% of students
- Academic leadership 88% of students

Additionally, the majority of students responded positively ("Moderately," "Quite a Bit," or "A Great Deal") to survey items regarding their perceptions of the significance or impact of the program, such as:

- Did the CNS program increase your potential for employment opportunities? 93% of students
- Were the courses relevant to your intended profession? 100% of students
- Were you satisfied with the CNS Program overall? 86% of students

Survey results also indicated areas for program improvement. Nearly half of the survey respondents (47%) expressed that more hands on activities were needed in the program, and responses to open-ended survey questions indicated that increasing the available physical resources was a necessary step to making this possible. The need for more hardware, such as routers, firewalls, switchers and servers, was indicated by 26% of survey respondents, while nearly 17% of survey respondents indicated a need for more physical lab space. Just over 14% of respondents indicated a desire for a wider variety of technical courses available in the CNS degree program curriculum.

Data culture and perspectives on the use of data. An institutional research analyst presented her impression that evaluation data were primarily used for continuous improvement of WU programs and services:

> This is the kind of institution where, even if something looks negative, we just see that as an opportunity to do better. People aren't afraid to report bad results here. Because every school is going to have bad results. And to say that everything is perfect all the time is obviously a lie (EC, p. 8).

This philosophy of focusing on improvement was echoed in the CNS Department Chair's discussion of working with adjunct faculty to address poor student evaluation scores.

The IR office allows any faculty or staff member to make data requests through a ticketing system. However, there are only two staff members in the IRB department, so they look to share the work when appropriate. They are working to teach staff members in key departments to be able to enter University data systems to "go in and see their results; perhaps not to manipulate the data" (EC, p. 3). The Institutional Research group is striving to encourage others to take ownership of their department's data to a degree – to increase their understanding and comfort level with available data.

The institution as a whole is "getting better at publishing data on the web," according to an institutional research analyst. In the past, data analysis results were kept "hush, hush," but now there are efforts to branch out so "anyone who works here can access it" (EC, p. 4). Our research team noted that the College of Technology Dean mentioned that all formative and summative assessment plans and outcomes are available on the College's website. We have not been able to find this. We see the competencies for each of the college majors, but that is the extent of the outcomes measures or information.

DAYTONA STATE COLLEGE'S BACHELORS OF SCIENCE IN ENGINEERING TECHNOLOGY (BSET)

Daytona State College (DSC) is a public, primarily associate degree-granting institution that also offers baccalaureate degrees. The college enrolls over 16,000 students, nearly half (45%) of whom are enrolled part-time (IPEDS, 2011). DSC was founded in 1957 as "Florida's first comprehensive community college" (fast fact, quickguide artifact). DSC has six campuses located in Volusia and Flagler Counties.

In 2001 the state of Florida created legislation, which provided a process for community colleges to add baccalaureate degrees (AASCU, 2010). In December 2005, DSC, at the time called Daytona Beach Community College, was granted permission to award baccalaureate degrees. According to institutional administrators this change called for a new mission statement and new admissions policies for the baccalaureate degrees, but "the overall functioning of the institution" has not changed very much (V. p. 6). The name of the community college was changed in 2008 to reflect the transformation from a community college to a member of Florida's State College System (Orlando Sentinel, June 21, 2008).

Institutional View of Applied Education and Degree Pathways

To be granted permission to develop a baccalaureate degree program by the Board of Education in Florida, an institution must conduct a needs assessment for that degree both locally and regionally (V p.12). One institutional administrator explained:

> When we did our needs assessment in this area, what we really came up with was a need for people who have earned an associate of science degree [to have] an opportunity to earn a bachelor's degree without having to really go back and make up a lot of missed classwork. (V, p. 1)

The first applied baccalaureate degree offered by DSC was the BAS in Supervision Management, added in 2006. This degree was soon followed in the spring of 2009 by a BS in Education (BSED) to meet the need for STEM educators in Florida. The BS in Engineering Technology (BSET) followed with the program first offered during fall 2010 at DSC (http://www.daytonastate.edu/catalog/facts/history.html, retrieved April 12, 2013). To date, these are the only bachelor's degrees awarded by DSC. In contrast, there are over 90 associate degree programs and over 50 certificate programs available at DSC (http://www.daytonastate.edu/catalog/files/Academic%20Program%20Code%20Listing.pdf).

DSC Current Students

In Fall 2011, a total of 16,555 students were enrolled in undergraduate degree programs at DSC (715 of those as transfer-in undergraduate students) (IPEDS College Navigator, Fall 2011). Of those students, 45% attend full-time and 55% attend part-time. Approximately 39% of undergraduate students are male, and 61% are female. A total of 71% of the undergraduate student body self-identified as White / Caucasian, 13% as Black or African American, 11% as Hispanic/Latino, 2% as Asian, 1% as American Indian/Alaska Native, and 1% as two or more races. Race ethnicity unknown was reported for 1% of undergraduate students. Just over half (56%) of the students are ages 24 and under, with 44% ages 25 and older. The majority of students (97%) are in-state residents.

In 2011, approximately 44% of entering students were counted as "first-time, full-time" students. Of full-time, first-time degree- or certificate-seeking students who began their studies in Fall 2005, 29% graduated and 10% transferred-out within 150% of the typical completion time for their program. Graduation rates were comparable for male students (30%) and female students (28%). Graduation rates

were lower for Black/African American students (12%) than many of their peers from other race/ethnicity groups: Asian (38%), American Indian/Alaska Native (33%), Hispanic/Latino (32%), White/Caucasian (32%), Race/Ethnicity Unknown (18%).

Across DSC the student-to-faculty ratio is 14:1. The IPEDS data from Fall 2011 reports 318 employed full-time faculty and 813 part-time faculty, all primarily serving in instructional roles.

The BSET Degree Program

BAS degree program development. The first two bachelor's degrees offered by DSC (the BAS in Supervision Management and the BS in Education) were developed internally by faculty at DSC. The development of the BSET degree followed a considerably different path.

DSC's Advanced Technology College (ATC) facility had been originally built to house a joint venture between DSC and Flagler and Volusia School Districts to house high school programs that bridged the gap between high school and college, accelerating student progress toward postsecondary credentials. However, financial hardships required the school districts to discontinue these programs, leaving much of the ATC unused (V, p. 4). DSC administration recognized this open space as an opportunity, and desired to develop engineering program on campus. The summer of 2009 provided a set of circumstances that would allow DSC to launch a program with unusual speed.

As reported in the *Orlando Sentinel*, the University of Central Florida (UCF) decided to "eliminate four academic programs and to suspend a fifth to make do with millions less in state money" (Zaragoza, July 24, 2009). One of the programs to be "chopped" was the BS degree in Engineering Technology from UCF's College of Engineering and Computer Science, which had three degree specialization areas and offered upper-level courses as part of a 2+2 degree program model where students transferred in with an associate degree with the intention of completing the bachelor's degree. This degree program had been in existence at UCF since 1972. There was much discussion regarding what to do with the degree program, and where the faculty may go once the program was closed. Initially, a leading option was to divide UCF's Engineering Technology program and faculty between Seminole State College and Valencia Community College, giving each college a degree specialization area. Considered by institutional administrators, this option was not appealing to the Engineering Technology faculty. Faculty's area of expertise was not tied to one specific degree specialization area, so attempts to divide the degree specializations among different institutions would have split faculty as well, creating an uneven distribution of expertise (V, p. 4).

DSC administrators were quick to see the opportunity that the degree program closure at UCF created for their institution. Combining the available space at the ATC, with their existing interest in creating an engineering program at DSC and the availability of a full faculty group who desired to continue to work together, DSC administrators worked quickly to build a case for moving the UCF BSET degree program to DSC. Additional arguments made for why DSC was an ideal location for the BSET degree program included: (a) DSC's existing associate degree programs in engineering technology and related fields that would serve as pipelines for encouraging students to pursue the bachelor's degree, and (b) DSC's existing state approvals for awarding bachelor's degrees (as reported in *Daytona Beach News Journal*, Harper, March 2, 2010).

The full process of moving the BSET degree program took nearly a year. DSC began by hiring 10 faculty members from the UCF degree program to be a part of the new degree program, to be housed within the School of Engineering Technology. They then began the process to gain the Florida State Board of

Education's approval for the new degree program to be offered at DSC. The original plan was to laterally transfer all three degree programs from UCF to DSC. However, the Florida State Board of Education directed that the program be condensed into one degree program with three concentrations. DSC complied to move the approval process along quickly. Approval was obtained in the spring of 2010, leaving only a few short summer months to transition the curriculum, courses, materials, and faculty from UCF to DSC before courses began in Fall 2010.

During our site visit in Fall 2012, DSC faculty and administrators reflected on the transition from UCF to DSC stating that the program has been "maintained and strengthened" (RE, 2011, p. 2) through the move. One important factor contributing to program improvement has been bridging the gap for students by bringing the AS and BS degrees together into one institution. The BSET program at UCF had previously only offered the upper-division bachelor's degree courses – the final two years of coursework required for the bachelor's degree. Having both programs within one institution has helped students develop a better understanding of the curriculum and requirements, while also helping program instructors and administrators gain a better understanding of students' strengths and needs throughout their undergraduate experience.

Looking forward, the BSET administrators and faculty also shared that the program is continuing to evolve at DSC. For example, as they look to pursue ABET accreditation at DSC, they have recognized that the consolidation of the three degree program areas into concentrations presents a challenge due to the difference in accreditation standards for each of the areas. For this reason, they plan to return to the Florida State Board of Education with a petition to split the degree back into three separate degree programs, similar to the design at UCF. There is hope that now, without the time pressure that they were experiencing while trying to move the program and with presenting evidence regarding accreditation needs, they will be able to present a clear case for the need for his change.

Program learning goals and objectives. The program website lists learning outcomes for each of the three BSET program curricula. For the Bachelors of Science in Engineering Technology -Industrial Systems Program, graduates of the program will be able to:

1. Demonstrate appropriate mastery of the knowledge, techniques, skills, and modern tools of engineering technology.
2. Demonstrate ability to apply current knowledge and adapt to emerging applications and technology.
3. Demonstrate ability to conduct, analyze, and interpret experiments.
4. Apply creativity in the design of projects.
5. Demonstrate ability to function effectively on teams.
6. Demonstrate technical problem solving competencies.
7. Demonstrate written and oral communication competencies.
8. Recognize the need to engage in lifelong learning through formal and informal study.
9. Demonstrate understanding of professional, ethical, and social responsibilities.
10. Demonstrate respect for diversity, and a knowledge of contemporary professional, social and global issues.
11. Display commitment to quality, timeliness, and continuous improvement.

http://www.daytonastate.edu/CollegeCatalog/ProgramGuide.aspx?major=6331&cat=CC14&major2no=1444

For the Electrical Systems Concentration of the BSET program, graduates of the program will be able to:

1. Apply basic knowledge in electronic, electrical circuit analysis, power systems, microprocessors, photonics, programmable logic controller, and control systems.
2. Apply basic mathematical, scientific, and engineering concepts to technical problem solving.
3. Conduct experiments, and then analyze and interpret results.
4. Apply creativity through the use of project-based work to design circuits, systems or processes.
5. Work effectively in teams.
6. Demonstrate a working knowledge of computer usage, including the use of one or more computer software packages for technical problem solving.
7. Communicate effectively orally, visually, and in writing.
8. Recognize the need for lifelong learning and be prepared to continue their education through formal or informal study.
9. Demonstrate an understanding of professional, ethical and social responsibilities.
10. Demonstrate respect for diversity and a knowledge of contemporary professional, social and global issues.
11. Demonstrate a commitment to quality, timeliness, and continuous improvement.

http://www.daytonastate.edu/CollegeCatalog/ProgramGuide.aspx?major=6333&cat=CC14&major2no=1446

For the Information Systems Concentration of the BSET program, graduates of the program will be able to:

1. Apply knowledge of computing and mathematics appropriate to the discipline.
2. Analyze a problem, and identify and define the computing requirements appropriate to its solution.
3. Design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.
4. Function effectively on teams to accomplish a common goal.
5. Demonstrate an understanding of professional, ethical, legal, security, and social issues and responsibilities.
6. Communicate effectively with a range of audiences.
7. Analyze the local and global impact of computing on individuals, organizations and society.
8. Recognize the need for, and an ability to engage in, continuing professional development.
9. Use current techniques, skills, and tools necessary for computing practices.
10. Demonstrate an understanding of processes that support the delivery and management of information systems within a specific application environment.

http://www.daytonastate.edu/CollegeCatalog/ProgramGuide.aspx?major=6332&cat=CC14&major2no=1445

Each of these learning outcome lists addresses both discipline specific skills (e.g., apply knowledge of computing, apply knowledge in electrical circuit analysis) and general or liberal education outcomes. The general education outcomes shared across all three programs include: commitment to lifelong learning and professional development, communication, creativity, experimentation, global and social responsiveness, problem solving, professionalism and ethics, respect for diversity, and teamwork.

Curriculum design. The BSET degree is designed to accept AS and AAS degrees in a diverse array of engineering fields (e.g., manufacturing, electrical engineering technology, information technology). For example, articulation agreements exist with Brevard Community College's AS degree program in Engineering Technology and Hillsborough Community Colleges' AS/AAS degree programs in Engineering Technology. Additionally, students transfer to the BSET program from a variety of non-engineering associate degree programs across Florida.

There are three BSET curriculum options for students – one standalone program in Engineering Technology (which is referred to as the Industrial Systems Program in some areas of the website) and two concentrations. The standalone BSET program prepares graduates for technical positions in industrial operations, mechanical design, and construction design. The Electrical Engineering Technology concentration prepares graduates for technical positions in electrical, digital, computers, and microprocessor fields. The Information Systems Technology concentration prepares graduates for technical positions in information systems management, information technology, network security, and digital forensics fields.

Program administrators report that curricula are "seamless" for those who transfer within a particular focus area – for example, transitioning from an associate degree in Electrical Engineering Technology to a the bachelor's degree concentration in Electrical Engineering Technology. However, "most students do not have such a linear path through their programs" (RE, 2011, p. 2). Students tend to bring a variety of different associate degree credits, credit for military service, apprenticeship programs, and so on. Each of these experiences has elements that can contribute to upper level coursework, and DSC works with students to accept as much prior credit as possible. One program administrator noted that it is "notoriously difficult" (RE, 2011, p. 2) to figure out what credits may be applied based on completion of apprenticeship programs (e.g., HVAC, machinist, welding). During the 2011-2012 academic year, ongoing statewide discussions were going on in Florida to clarify the acceptance of credits based on apprenticeship programs.

At the time of the current visit in fall 2012, the BSET was made up of 128 credit hours, with 44 hours coming from students' associate degree program of study, 36 hours of general education core requirements, and 48 hours of BSET core, concentration, and elective credit. (Although we are aware that recent Florida legislation [Florida Statute 1007.25 section 8] has now changed the general education requirements to 30 credit hours as of fall 2013, and we expect to see some modifications to these course requirements as a result.) Students entering the BSET program are required to have completed an associate degree program with an overall GPA of 2.5 or above. Additionally, the completion of College Algebra with a grade of C or better is required for admission. Those who have not completed an associate degree, but have earned at least 60 credit hours that are transferrable to the BSET program, may be admitted with approval of the Program Chair. Essentially, gaining admissions into the program requires the "equivalent of a two-year degree" (RE, 2012, p.1), but there are a variety of ways that requirement can be marked. Students bring in credits from many sources, and program administrators must look at "all the puzzle pieces to see what fits – or what fits well enough" (RE, 2012, p. 1).

General education. The State of Florida previously required 36 general education credit hours for bachelor's degrees, but legislation in the state recently changed this requirement to 30 general education credits for bachelor's degrees (Florida Statute 1007.25 section 8). The specific requirements for those general education credits can differ from one associate degree to another. At the time of our visit in fall 2012, students from AS or AAS degree programs typically transfer in between 15 – 18 credit hours, as well as a number of technical credit hours. AA degree graduates typically transfer in all 36 required general education credits, but are then required to complete an additional 18 credit hours of technical prerequisite coursework in their chosen occupational or technical area.

Math requirements. BSET students must complete a math sequence up through Calculus I. Most students who enter the BSET program have not continued in their math sequence past College Algebra, leaving several mathematics courses to complete. Some of those classes can be applied toward general education requirements – typically around 6 credit hours. Yet, the challenge remains to figure out how requirements and schedules can be organized to best fit the needs of each unique student.

To provide some flexibility to students, the BSET degree program has two math sequence options. One of these options includes courses through calculus and then allows students to take applied math courses to complete the sequence. These applied math courses are specific to the field of engineering and includes differential equations within them. Students' second option is to take the traditional math sequence with the full calculus sequence. Students are able to choose which math sequence to take, and do so in consultation with an advisor. Students wishing to pursue a graduate education in science or engineering are encouraged to take the traditional calculus sequence (RE1 p. 3).

The administrators for the BSET program explain that for a student to start in remedial math courses and complete the required math sequence for the BSET degree, that student would need to complete over eight math courses. Offering 8-week courses helps students progress through these courses. BSET administrators have had students start in the remedial math courses and successfully complete the required math and earn a degree (RE1 p.2).

Course sequencing. In addition to the different calculus courses offered depending on the student's ultimate career goals, the BSET program also offers engineering versions of the engineering technology courses, which is one benefit of the program having been originally developed at UCF, a primarily baccalaureate degree-granting institution with an engineering department. While students are required to take the engineering technology course, which are based on Calculus 1, the engineering versions of those courses based on differential equations are also offered for students planning to pursue graduate education (RE1 p.4).

Academic tracks. One program administrator mentioned a further benefit of having multiple degree programs at one institution explaining that, those students who find they cannot make it through the required math and science courses have other options to turn to. For example, vocational education takes place in the same spaces and facilities as the BSET program. This recognizes a continuum of engineering curricula along a career pathway – for example, HVAC, with its hands-on nature, is a part of the engineering skill set and pathway. Students have access to several engineering-related career options.

Enrollment and Student Demographics

According to BSET administrators, when the BSET degree program existed at University of Central Florida, approximately 150 – 200 students graduated from the program each year. According to the DSC Institutional Research website, in its first year at DSC (2010-2011), the BSET program enrolled 183 students and grew to enroll 328 students in the 2011-2012 academic year (http://www.daytonastate.edu/ir/files/annual%20headcount%20by%20major.pdf). [By contrast, according to College of Technology administrators, the associate degree programs in the College of Technology enrolled 700-800 students in the same year, with capacity to grow to 1,200 students.] In 2010-2011, the BSET program at DSC graduated 2 students and grew to graduate 17 students in the 2011-2012 academic year (http://www.daytonastate.edu/ir/files/Graduates%20by%20Major.pdf). College of Technology administrators estimate the number of graduates will grow to 100 per year in the near future. A challenge in estimating graduation rates relates to the fact that many of their students are enrolled part-time. Even though the BSET is a two-year program (students must have completed a two-year associate degree prior to enrollment), on average students take three to four years to complete the upper-level courses.

Yet, challenges exist to growing a program this large. There is concern about the ability to recruit students to STEM programs. One program administrator suggested that science literacy and math-intensive classes are viewed as a struggle when not enough students come out of the K-12 system with strong math and science backgrounds. He shared that the challenge is further exacerbated by a shortage of K-12 teachers with math and science background in Florida. Students do not understand the material and do not want to move on to a math or science career. Then, when they get to industry, these same students "hit a wall" because they do not have the necessary background to succeed.

One administrator within the School of Technology estimates that approximately 70-80% of the BSET students are former AS or AA students from DSC. The BSET program is marketed heavily to DSC graduates, so many of the current BSET students have earned their associate degree from DSC and returned to complete the BSET program. The administrator predicts the percentage of native students will continue to grow as the program grows, saying: "…in the next couple of years, I think the trend is going to change because we are already seeing students who are coming in with an intention of continuing on to our BSET program" (AP, p. 3).

DSC's BSET program "attracts a large number of minority students" (RE, 2011, p. 7) without having specific recruiting efforts to reach out to these students. Program administrators report that there is a large minority population in the surrounding area and "our student population looks like the region" (RE, 2011, p. 7). The program also sees students who are veterans in addition to students from all ages, including students who finished their degrees earlier in their career and are coming back for additional degrees, as well as students who may have started but never completed a degree. It is also estimated that over 50% of the BSET students are already working. Two particularly large student populations in the program tend to be displaced or unemployed workers and English language learners. It is a challenge, however, to recruit females to the program.

Approximately 15% of students currently in the program are female. Despite large scale recruiting efforts targeting women, they have not been able to increase this percentage. One program administrator reflects on this challenge in the following way:

> Many females are discouraged by teachers and their peers when they are told that engineering is a male dominated field. It is hard to get them to the field unless they have a passion to make things. Female students who do enter are driven. They do well in the field when they really want it. (RE, 2011, p. 7)

Although females are clearly outnumbered by males in the program, those females who do enter the program are typically successful in classes and persist to complete the degree at higher percentage rates than males.

Recruitment. The effort to recruit students was discussed several times by DSC administrators and faculty. The ATC holds Open House events with the intention of recruiting high school students, as well as people wishing to advance or change their career. These Open House events include a tour of the facilities, an opportunity for prospective students to talk directly with faculty, and visual displays of the degree programs housed in the ATC. The poster display for the BSET programs includes descriptions of all three BSET curricula, which are described as opportunities to "broaden your knowledge of applied engineering practices." The BSET degree program is also advertised as being "designed to provide a flexible schedule featuring a combination of traditional and online course" and "open to students who have earned an Associates degree."

In addition to these Open House activities, which are organized by Admissions, the College of Technology has created large poster displays in partnership with the local manufacturers association in an effort to bring awareness to the possible job opportunities with degrees offered at the ATC. These 8x10 foot posters line the hallways of the ATC, advertising job opportunities for all fields, including the BSET degree. One poster says, "As an Engineering Technologist, you'll do more than make plans. You'll make plans work!" Most of the posters are not promoting one specific degree program, but are displays created by the companies hiring DSC graduates. These displays list the job opportunities available at the specific company, many of which include opportunities for engineering technology graduates. RFID tags are also included on many of the posters, which link directly to the company websites and job postings. These posters are placed in the halls of the ATC nearest the classrooms and labs most relevant to the company's specialization. These posters hang in the ATC indefinitely. The only costs incurred by participating companies include the cost of the production and hanging of the poster.

Faculty Roles and Positions

Considering the role of faculty at DSC offers an intriguing glimpse into the intersection of academic cultures. DSC is a primarily associate-degree granting institution. Prior to the addition of the BSET degree program in fall 2010, the College of Technology offered only associate degrees. When the BSET program was added in fall 2010, the entire faculty for this program came, as a group, from UCF. UCF is a comprehensive research institution, serving undergraduate and graduate students, and requiring faculty to engage in teaching, research, service, and grant writing activities. In the first two years of the BSET degree program existing at DSC, there was little cross over in teaching responsibilities between the BSET program and the associate degree programs at DSC. Those who had taught associate degree courses at DSC continued to do so. Faculty who had transitioned from UCF continued to teach all bachelor's degree courses for the BSET degree, although a few of the BSET faculty members taught associate-level courses in order to maintain their course loads as the BSET program enrollment was not yet large enough in its initial years to maintain a staffing of 10 full-time faculty members. As reported by administrators in the School of Engineering Technology, this division of teaching responsibilities was not an intentional separation of faculty. It was simply out of necessity to get the new program off the ground in such a short period of time – people taught what they knew for the sake of efficiency. Yet, now they had two cultures working side-by-side, sometimes enhancing each other's experiences and other times experiencing friction.

Enhancing Teaching. At DSC, teaching is clearly the primary role of faculty members. As such, BSET faculty reported that they have experienced opportunities to focus on and enhance the teaching that they had not encountered at UCF or in other environments. For example, all faculty attend required monthly meetings where innovative teaching strategies are explored. Faculty members take turns providing brief presentations or demonstrations of the techniques they use in their classes, which spur discussion about further teaching innovations that faculty can bring into their classrooms. As one faculty member who had moved with the group from UCF explained, "I've never been any place where you…called the faculty members together in a meeting with the sole purpose of talking about how you teach, and you're required to give examples of how you do it" (RE1, p. 27).

Differences in Teaching. Bringing the bachelor's degree and the associate degree programs together under one roof at DSC also has made the contrast of teaching associate-level versus baccalaureate-level courses apparent. One faculty member described teaching associate-level courses as teaching students to follow a set of instructions, where the baccalaureate level courses require students to learn to think critically and problem-solve,

> When you teach a bachelor's class, you're trying to push the students a little bit further towards those critical thinking aspects of figuring out how to do it yourself. When you teach associate level course…It's a different aim. And at some point, they have to make that transition from the one type of thinking, follow instructions, do what you're told to do, to there are no instructions; figure out how to do it. (RE1, p. 1)

To make the process of teaching critical thinking skills concrete, the BSET faculty incorporate a strategy of requiring all bachelor's degree courses to provide at least one assignment with an open-ended question for students to complete entirely on their own, without step-by-step instructions that are often provided in associate degree program courses. The goal is to get the students thinking on their own, and solving problems on their own, just as they will be expected to do in the workforce.

The Place of Research and Service. While teaching is the top priority of DSC faculty with service playing a secondary role, the BSET faculty brought a different set of norms with them from UCF. The UCF culture of research was not left behind when they made the transition to DSC. While teaching has become a top priority for BSET faculty and research is not a required component of the faculty role at DSC, the BSET faculty still choose to engage in research, grant writing, publication, conference presentations, and service to academic communities. In some ways, this has posed challenges in the DSC environment. Committees were underway at DSC at the time of our site visit to create new policies and procedures necessary for facilitating research-based grants. Tensions were also expressed regarding faculty members' desire to be recognized for the amount of effort required to submit winning grant proposals.

In other ways, the infusion of the culture from the BSET faculty has created new opportunities. One BSET administrator shared that associate-degree faculty members at DSC who had never submitted a journal article in the past had now sought guidance from BSET faculty for advice on how to become engaged in the world of academic publishing (RE1, p. 21).

Other Priorities. As these new faculty roles of publishing, grant writing, and service to academic communities, became embedded into the DSC environment, BSET faculty expressed the need for the culture of DSC to recognize their efforts beyond teaching (FF p. 13). This a challenge they hope they will overcome as the program grows at DSC. Faculty who were highly engaged in securing grants, publishing, and serving on state and national committees felt that they were bringing national prominence to the degree program and to the institution as a whole. As such, these efforts should be recognized, and they felt that this was an area in which DSC as an institution could grow.

Along the way, the BSET faculty shared that they anticipate challenges to this growth. As an example, they shared a perception of tensions over salary differentials between associate degree faculty and BSET faculty. When BSET faculty made the transition from UCF, they were offered a higher salary than the typical associate degree faculty member receives. The BSET faculty members commented that this salary differential exists throughout the field of engineering. At UCF, they were on the other side of the differential, such that faculty teaching the BS in Engineering programs received higher salaries than the faculty in the BS in Engineering Technology programs.

Challenges and Areas of Concern

Older adult students and academic history. One program administrator discussed a difficulty in working with students who have previously unfinished degrees.

So now they're coming back with a totally different set of perspectives and a lot of demands on their time and things, but they do very, very well. But they're coming back already with a chip on their shoulder because we never drop that academic record. It follows you your entire life. So they have to actually fight against that academic record. (RE1 p. 18).

The existence of this prior academic record causes many hurdles for these students. According to an administrator, this academic record and number of credits that remains on their record can put their financial aid in jeopardy. A suggestion was made by one administrator to put a "statute of limitations" on grades for older adult students, so their previous experiences in higher education do not hinder their ability to complete a degree (RE).

Maintaining small class sizes. Administrators for the BSET program discuss their efforts to keep all classes below 25 students. This may change as they begin to enroll more students. Program administrators report there has been an "enrollment leap" because students can see the degree path (RE1, p. 14). Administrators explained the difficulty in keeping lower class sizes, especially in an engineering department where faculty earn more than the typical faculty member. The administrator continued to suggest that one way to fix this is to increase the size of the courses, but this model was done when the program was at UCF with courses of 100 students, and "our quality definitely suffered at that point" (RE1 p. 15). The effort to maintain small class sizes seems to reflect an effort to maintain program quality.

Sharing What Works: Program Quality

Faculty selection and training. BSET administrators shared that their process of selecting faculty to join their team was a key ingredient to the quality of their program. They are cautious in making their selections of new faculty, waiting for the "right person" with the skills and qualities to meet their needs, rather than rushing to fill positions with the first available person. This means that searches often take longer than one might desire, but when they do find the right person, the quality of that person's contributions to the department are high and they tend to stay with the position for an extended period of time.

Then, as previously discussed, BSET faculty are offered continued opportunities to deepen relationships across the department as they meet on a monthly basis to learn from each other's teaching techniques, in order to enhance their own practice.

Adherence to recognized standards.

Program-specific accreditation. When the BSET program was located at UCF in was accredited by the Accreditation Board for Engineering and Technology (ABET). Being a new program at DSC, the BSET program at DSC had not gone through the accrediting process of ABET. Yet, program administrators and faculty reported that many of the processes used by the BSET faculty at UCF have transferred over to their practices at DSC in order to prepare for future ABET evaluations. Before a new program can submit a Request for Evaluation the "program must have in place processes for internal assessment" (abet.org). This evaluation process than take 18 months to complete.

BSET program administrators at UCF started using an assessment-wiki to complete the required steps of ABET evaluation. The use of this wiki by the BSET program continues at DSC.

Regional accreditation. DSC is accredited by Southern Association of Colleges and Schools Commission on College (SACS) whose mission is "to assure the educational quality and improve the effectiveness of its member institutions" (sacs.org). Many of the institutional requirements for program evaluation are motivated by SACS, such as the requirement to have 2 cycles of evaluation every 3 years for programs. This is required by SACS, but program-specific accreditors may require these evaluations to be done more often. While evaluation practices in the BEST program seem primarily geared toward an interest in pursuing ABET accreditation, attention is also paid to attending to institution-wide evaluation requirements for SACS accreditation.

Collaborations to strengthen quality and effectiveness.

Industry advisors or advisory board. Program administrators reflect that the primary industries in the Daytona area are manufacturing, agriculture, and tourism. West Daytona is rural, and East Daytona consists of beachfront areas. Additionally, I-95 runs through Daytona, which is the major north-south interstate highway corridor that facilitates a large trucking and manufacturing sector. DSC works to attract employers to create partnerships that benefit the academic programs, faculty, and students. For example, at the associate degree level, students are required to complete an internship. Partnerships have been developed with local and regional companies to run the internship program. At the bachelor's level, employers are members of an Advisory Board, which "works to make sure that what we teach fits their employer needs" (RE, 2011, p. 5). Faculty report adding specific classes because of the industry advisor's recommendations (CM, p. 8). Furthermore, program administrators stress that the space, high-tech facilities, and experienced faculty (10 PhD engineers) provide opportunities to "create strategic partnerships" (RE, 2011, p. 5). There is a focus on attracting employers by demonstrating the value-added to the employment community.

Professional and community involvement.

Professional associations and boards. The College of Technology partners with local organizations, such as the Volusia Manufacturers Association (VMA), to spread awareness of the availability of manufacturing jobs. VMA organizes programs including presenting manufacturing careers speeches, recruiting judges for robotics competitions and employers for internship opportunities, and exploring mentoring opportunities. The association is making an effort to get local manufacturers involved in recruiting more students into pursuing jobs related to manufacturing (VMA brochure). The large posters that hang in the ATC advertising job opportunities at local companies is a program created as a partnership between College of Technology administrators, VMA representatives, and local businesses.

K-12 outreach. BSET faculty at DSC had the opportunity for K-12 outreach through the system of academies in Volusia County High Schools. The academies are based on specific disciplines including several engineering-based academies. These engineering academies introduce students to the field of engineering early in their education, so they can form an interest in the field. One faculty member reported being on the advisory board for an engineering academy. Faculty and administrators in the BSET program also meet with interested engineering students individually as well as in groups to inform them of the educational opportunities specifically at DSC, as well as more general engineering education information.

Sharing What Works: Educational Significance

Individual and societal needs addressed by the program.

Economic and employment needs. To be granted permission to offer the BSET at DSC, College of Technology administrators had to demonstrate a need for more graduates in the engineering technology field. The large manufacturing industry in Florida fuels the demand for educated workers. According to the recommendations of Baccalaureate Review Team for the Florida Board of Education, DSC reported that "the number of baccalaureate graduates in the program proposal area, even if all graduates remain in the state and immediately enter the workforce, the number of graduates is meeting less than 24

percent of the employment need…" (cite document on server). The elimination of the BSET degree at UCF increased the need for a BSET program at another institution, and the Baccalaureate Review Team reported that DSC had shown evidence that there was an unmet need in the region.

The demand for engineers in Florida was also voiced by a regional manufacturing representative who said,

> There's a shortage of engineers. What there's a real shortage of, and what you really have to work hard if your developing this in research, is that people truly have to be systems thinkers. That has to be built in here. You've got to have people that know how to go in and put together fail-proof systems because the reality is it's that system that is going to work and if we're not able to train the people that we know, if we have good systems in place, then you're still going to be able to get the job done (JF, FDE, p. 3).

Administrators of the BSET degree explain that workers are needed at all levels. They further explain that small companies who need employees with engineering backgrounds can especially benefit from graduates of engineering tech programs because of the lower salary required to employ them as well as the many overlapping skills they share with graduates from engineering programs (RE3 p. 16). Program administrators, as well as representatives from the local manufacturing industry, stress that despite the national dialogue regarding the economy, the manufacturing industry is doing well (RE3 p. 17 and Jane). The BSET program at DSC was developed to fulfill this regional need.

Academic and learning needs. The applied baccalaureate degrees available at DSC were also created to allow students with technical associate degrees a chance to go back to school to earn a bachelor's degree. According to an institutional administrator (V, p. 1)…

> "when we did our needs assessment in this area, what we really came up with was a need for people who have earned an associate of science degree an opportunity to earn a bachelor's degree without having to really go back and make up a lot of missed classwork…"

This was the finding when DSC first started offering AB degrees. This sentiment was echoed by an administrator in the School of Technology who reported that students with both the AA and AS degree needed an additional degree option. He explained that students with the AA degrees who were meant to transfer directly to the university found they were taking many more courses than planned, while the AS students had no transfer options to earn an advanced degree (Paul, p. 4). Understanding the need to continue to offer degree options to students with a variety of associate degrees has continued with the BSET program. The variety of AS/AAS degrees accepted by the BSET program presents a challenge to program administrators in designing the curriculum to meet the needs of a diverse group of students. One administrator explains that this is difficult "because you don't have a very homogenous input, you have incredibly diverse input." (RE, FDE, p. 6). The challenge of managing students with diverse academic needs presents itself when working with BSET students on course selection.

The program administrators also recognize the need to be sensitive to the different skill levels of incoming students. DSC is an open access, public institution. Faculty see some students at DSC struggle in ways that were not so apparent at UCF when admissions criteria were, perhaps, more stringent. A current DSC BSET faculty member reports noticing a need to hone students' understanding of foundational engineering principles were covered in associate degree classes at DSC, more so than when they were teaching courses at UCF. On the other hand, this switch from UCF to DSC has also provided many advantages to serving the students in the BSET program as well. Faculty members report increased communication with colleagues regarding certain students, as well as hearing anecdotally from

students that they were able to find more help at the ATC of DSC than when they were at UCF. The size of the program also offers an advantage to students. At UCF, the BSET program had approximately 700 students, the smaller size at DSC allows for much smaller class sizes. This faculty member also reported a higher level of program maturity as a faculty improved their online teaching strategies. (CM, p. 6-7). A program administrator explained:

> Our perspective of 2+2 here is so different because there was no 2 to the plus 2 at UCF. They were all transfer students coming from other institutions. There are still transfer students coming from other institutions, but now we're serving and seeing students that are coming from our own institution, so we actually get a much better feel for what those needs are. Whereas UCF, they were left to fend for themselves. We don't do that here. We actually provide all the services necessary, so that was a totally different thing (RE2).

One benefit to having both portions of the 2+2 program offered at DSC is that remediation is handled by the people who work with students in their associate degree program, but it is all at the same institution, which allows the administrators and faculty in the BSET program work with the people who handle remediation.

Efforts have also been made in the BSET program to promote critical thinking skills and independent problem solving, an important skill for employees called for by industry representatives (RE, FDE, p. 9). A regional manufacturing representative stressed the need for graduates to have critical thinking skills as well as soft skills including "how to work in a team" and "how to communicate." (JF, FDE, p. 3, 9). These needs were echoed by an administrator in the School of Technology (AP, p 12).

Instructional Pedagogy.

Engaging students at various skill levels. Students in the BSET program enter with a variety of education and work backgrounds. The student population seen at DSC in the BSET program is much different from the student population seen when the BSET was offered at UCF. Students who entered the program from UCF were filtered through UCF's admissions policies. At DSC, faculty saw students with "an entire spectrum of capabilities." Students enter the program struggling to understand basic concepts, while other students are advancing at a quicker pace. This is one motivation for the design of the online curriculum used in the BSET program. Changing the way the curriculum was taught is one way the faculty had adjusted to teaching this new population of students (RE1 p. 17).

One faculty member encourages students from more advanced academic levels in the course to help students in the courses on the online bulletin boards. Students are able to earn extra credit by helping their peers online (RE3, p. 10). An example was provided regarding a web programming course. The course includes five students who currently are working in the web programming field, so encouraging those students to take more of a teaching role in the course benefits the students who are online and are unable to access the tutoring services at the ATC, while also encouraging the advanced students to tackle more challenging problems (RE3 p. 10).

The availability of two different math sequences for students with different career aspirations discussed previously also is an effort to accommodate students with different skill levels.

Online education. Online education has had a growing presence at DSC. The shift began approximately 10 years ago, when faculty were given opportunities to experiment with online course formats. In Spring 2012, the majority of courses were offered online –7 courses were offered in a face-to-face classroom format, while 32 courses were offered online. Evaluations have been conducted to compare the quality of online courses to classroom-based courses, with quality defined in terms of student

outcomes. Similar pass rates were found for students when comparing the online courses to classroom-based courses in introductory math classes. However, students in the online courses were found to, on average, perform one grade point higher in the next math class, as compared to students in the classroom-based courses. While the program administrators do not have data to explain the reason for this difference, one person hypothesized that:

> Students [in classroom-based classes] learn by watching the teacher solve problems. Online students learn by solving the problems themselves. They learn through application. Students learn better through their failures, and the opportunities to correct those failures, than they do through their successes. Students in the online environment who make mistakes must correct it on their own, rather than having a teacher show them where they went wrong. (RE, 2011, p. 8)

This dynamic of more active and independent learning that is encouraged by the online environment is proposed to make a difference in students' future successes.

The BSET program at UCF was approximately 85% online, according to one DSC BSET administrator. The movement of the entire program to an online format at DSC was the decision of the faculty. They could decide if they wanted to teach their course in person or online. The format of the course online is such that students are required to complete a certain number of online assignments. They complete the assignments before they watch the lecture videos. An interesting practice started by one faculty member was to allow students to view the written assignments of other students using online software. Faculty noticed the quality of the assignments turned in by the students dramatically increased when students knew the audience for the assignment was not only the faculty member, but their peers as well. In addition, cases of plagiarism also decreased (RE3).

In designing the online curriculum, administrators and faculty associated with the BSET program discussed the possibility that online courses can be better than live courses, especially for engineering students.

> I started realizing there were techniques that you could use that made it better than a live course. And it's really better in the concept of student outcomes, what you get the students to do. Because instead of going in and lecturing and then hoping the students retain the lecture materials and then trying to reinforce that with study of concepts, we don't do that. We start with -- This is engineering. Students have to be able to do things. So we start with the concept of what do they have to be able to do and then preparing them to be able to do those things. And lecture is not really the most effective way to do that. (RE1, 2012, p. 1)

The online courses in the BSET program do not follow the traditional format of classroom-based instruction that includes lecture, homework and exams. Faculty pre-record lectures that are approximately 15 minutes in length (RE1 p.11). Students may observe these lectures at any time—multiple times. Faculty also conduct synchronous, online meeting times for discussion as well as monitor asynchronous discussion boards. Students are required to complete assignments, labs and simulations in addition to viewing the online lectures.

Faculty who taught the BSET program at UCF were required to attend training if they were conducting online courses. After moving to DSC, administrators in the BSET program recognized the need for faculty collaboration to improve the quality of online courses. Rather than conduct formalized training, faculty meet once a month. During these meetings faculty members will give short presentations about something they are doing in their course to help improve student outcomes. Student outcomes are discussed and faculty are able to share what has and has not worked well for them in the online teaching environment (RE1, p. 10).

Strengths and weakness of online education. The faculty group discussed the benefits and drawbacks of teaching entirely online. One drawback included the loss of student feedback in courses. A faculty member discussed the benefits to seeing the students' facial expressions and activity during course lectures, which is lost online. Faculty also discuss that online courses require a more mature student who can manage their own schedule.

On the other hand, the faculty members recognized the benefit the students have in being able to rewind or replay lectures that are available online. In addition to the student's ability to listen to lectures at their own pace, the faculty can also monitor the discussion boards to determine which topics may need more emphasis or explaining through additional lecture video. One faculty member hypothesized that students felt more comfortable asking questions through an online interface rather than raising their hand in a classroom. Faculty also reported not only providing on campus office hours, but also having virtual office hours, so online students have the same ability to contact faculty online in the evening or on weekends. They also have many methods of communication including Skype, email, discussion boards, and phone (FF, p. 2). Students also have the benefit of being able to complete exams at their convenience, which is helpful since some of the students are working parents (FF, p.2).

Faculty recognized the hesitation some encounter when speaking about online, distance learning, but emphasized the need for online learning to be done "correctly."

> But there's just a varying quality, and I don't know if that's because there's a lot of pushback, because distance learning, to do it right, is very difficult and requires a change in the mindset. And everywhere I've been, there are half the faculty that say, "No, I don't want to do that." You know why? Because change is hard, and people don't want to change. (FF p. 5)

Faculty in the BSET program at DSC have made efforts to alter the way they teach online to fit the needs of the student to provide students with more opportunity and flexibility. They believe they are getting better at online teaching in the BSET program and recognize how new distance learning is and are open to allowing their methods to evolve as they learn more (FF, p. 5).

Desktop video publishing. Another new and evolving practice for the online portion of the BSET degree program is that all faculty are beginning to use desktop video recording to produce a 15-30 minute lecture each day. The videos are used for classes to help students brush up on prerequisite skills or topics on which they need extra instruction. A challenge in producing this resource has been to figure out how to organize and index the video trainings so that they may be made available outside of the model of traditional courses. It is hoped that these videos will be particularly helpful in getting remedial education students through the program – "all too often, when [remedial education] students encounter difficulties or new materials, they meet those challenges with resistance" (RE, 2011, p. 11). The faculty are actively seeking new approaches to overcome that resistance and to engage students with needed supports.

Faculty discuss benefits to using online recorded lectures including the ability for faculty to edit the lecture videos. One faculty member reports spending between 30-45 minutes editing a 7 minute lecture because they remove all of the pauses, technical difficulties experienced during lecture, or other distractions that might occur while recording. The same faculty member describes the common classroom situation where the projector is not working or the computer is not working and the teacher is required to take time away from lecture to fix the issue. This does not happen during recorded lectures because the teacher can edit the lecture video to eliminate all of the technical issues and pauses (FF, p. 4).

Applied and hands-on learning. The 2+2 structure of the degree program means that students are coming into the BSET program with prior hands-on experience if students have an A.S. technical degree.

The A.S. experience of the BSET students is described as following directions rather than engaging in analytical thinking according to program faculty and administrators. The transition from the A.S. curriculum to the BSET curriculum requires more analytical thinking by the students. The online courses in the BSET program are taught with this in mind (RE1, 2012, p.1).

A faculty member explained the options for exposing online students to the applied skills required of some programs. One option is to use the traveling video team available to faculty to record any applied or hands-on tasks. Although the BSET program does not currently offer lab kits to online students, one faculty member proposed a possible solution to including more hands-on learning in online courses was to develop lab kits so some of the equipment can be used at home by the student (FF, p. 4). Members of the faulty do acknowledge the limitation to online learning. "While the videos, I think, get you 75% there, I think you still need to hold those things in your hand and actually work with them." (FF p. 5). Some courses work very well online, but some students do need to have access to lab equipment on campus.

Course scheduling and condensed course schedule. Examining retention and course enrollment data, DSC faculty recognized that students tend to drop classes when they are past the half way mark of the 15-week semester. In fact, they found that the halfway point of 8 weeks is about the time that students "begin to struggle" with the material. To address this issue, faculty members reorganized many of their classes into two 8-week terms per semester, allowing students to break and refresh their focus before they "get into trouble" (RE, 2011, p. 10). In fact, some faculty in the BSET degree program were in the process of modifying the complete degree program to be offered in 8 week segments "to see if it increases the retention rate" (p. 10). This willingness to experiment with curriculum structures to help students overcome challenges to degree completion was observed in several areas across the program.

Critical thinking. Both faculty and administrators in the BSET program discussed the need to encourage critical thinking among their BSET students. In order to accomplish this, all bachelor's-level courses provide an open-ended question for students to complete entirely on their own without step-by-step instructions that are often provided in many associate degree program courses. Faculty report a variety of reactions from students. Faculty hope students will tackle the problems on their own, but some students search for instructions and others complain that the problem is too hard without more direction. The goal is to get the students thinking on their own and solving problems on their own, just as they will be expected to do in the workforce. A representative from the manufacturing industry agrees that the ability to think critically is an important quality for a BSET student (FDE, p. 9). Faculty in the BSET program recognize the need to push the students to develop systems thinking, especially at the baccalaureate-level.

Supports provided to help students achieve positive results and outcomes.

Associate program supports. DSC employs a dedicated retention coordinator "whose job it is to retain students" (RE, 2011, p. 8). They shared that "associate degree students are notoriously difficult to get through programs. They take a class or two and drop. Get a job and drop. Have family issues and drop. Have any life issues and drop" (RE, 2011, p. 8). In addition to a retention coordinator, the associate students have the service of a work experience coordinator whose primary responsibility is to make contacts with industry to provide co-op and internship opportunities (Paul, p 12). Students pursuing their associate degree at DSC take part in the College of Engineering Technology and Occupational Programs Work-Based Learning Program, which, according to a program brochure, offers "work-based technical learning experience to students enrolled in the College of Engineering Technology and Occupational Programs, through cooperative education/internships, job shadowing experiences, and industry tours" (artifact brochure). This program, similar to the retention coordinator is exclusively offered to associate degree-seeking students because of the funding sources for the Work Experience Coordinator.

At this time, it is not clear what retention, internship, or co-op support services are extended to students in the BSET degree programs. However, a foundation for these programs exists in the DSC environment, and program administrators indicated intentions to seek extensions of these resources and supports to dedicate to BSET students as the program continues to build its foundations and enrollment numbers increase.

Supports continue to BSET.

Financial aid. Financial aid eligibility is a concern for administrators in BSET program. Program administrators explain:

> The majority of students may have had a previous degree…they've got a previous degree, or maybe 2, say 2 previous degrees and 1 attempted and not completed, they are already going to be over your total number of hours, so they go on financial aid appeal from day one. They fail or withdraw from any course at all, they are dropped from financial aid, which in most cases spells that they'll never be able to complete the program. [RE2, p.1-2]

The BSET program administrators work with the financial aid office at DSC to carefully go through previous coursework to ensure the student receives as much credit as possible from previous coursework. This is especially important when working with students with a large amount of previous credit hours who may be approaching the number of credit hours that will limit their eligibility for federal financial aid programs. The threat of financial aid ineligibility has made students more cautious about dropping or failing courses.

Advising. Upon entry to the BSET program, all students meet with College of Technology administrators. Students in the BSET degree then may go to academic advisors on the main campus, but the BSET program faculty provide substantial support in an advising role because of the complexity of the advising tracks for engineering students (RE3, p. 1). Program administrators for the BSET degree program report working with other units on a daily basis to strategize which credits may transfer and how each student can progress through the program in the most efficient manner. Although these program administrators aim to "get students out the door in 128 credit hours," they find that "it is rare that this happens" (RE, 2011, p. 2) because students do not follow a linear path through postsecondary programs. The average student at DSC is in their late 30s. Many have accumulated college credits over a 10 – 15 year span, starting and stopping in 3 or 4 different degree programs. As one program administrator states: "we see these people, and they ask 'what do I do now?'" (RE, 2011, p. 2).

Academic support services. DSC's Division of Library and Academic Student Services, which includes the Writing Center and the Academic Support Center among other services, assists DSC students and faculty at all campuses with library resources, access to computers, tutoring, and writing feedback. The Writing Center services are offered in cooperation with UCF providing writing consultation to members of the DSC and UCF community. "Virtual tutoring sessions" are also available for online students. The Academic Support Center provides tutoring services for all DSC Campuses. The mission of the Academic Support Center "is to promote learning and help students achieve their potential by providing the resources they need to become successful, independent learners." The Academic Support Center services include individual and group walk-in tutoring, as well as online tutoring. Tutors include peers who are required to have a 3.0 GPA and a recommendation from a faculty member. Peer tutors are also required to complete a tutor training program. Professional, degreed tutors are also available. These full-time, professional tutors are known as Learning Specialists.

Tutoring services for all courses are available at the ATC. Services include a full-time Learning Specialist with a bachelor's degree in engineering who has regular hours on the ATC to assist the engineering

technology students with their coursework. When asked which students tend to seek tutoring services, one Learning Specialist shared that students in developmental math and English courses are required to complete course assignments in the tutoring lab on the main campus, which introduces those students to the academic support services available. However, Learning Specialists reported seeing mostly adult students take advantage of the on-campus tutoring resources at the ATC. She hypothesized that this was due to the maturity of the older students and the ability for those students to recognize when they are in need of assistance with coursework. Further, many of the students who use tutoring services at the ATC become repeat visitors. As she explained, "Generally once they know you're here and can help they come back. I like the repeat business. And you get to know them too, which is fun because you get to see them progress" (ES p. 2).

One challenge a current Learning Specialist recognizes to providing tutoring services for the engineering technology students is the online nature of the degree program. Many students do not attend classes on a DSC campus, so efforts have been made to offer tutoring services online. One Learning Specialist mentioned personal efforts of using online resources such as Adobe Connect or Facebook to tutor and reported a huge following for these informal online tutoring resources. Information from the Academic Success Center mentions online tutoring available through a national online tutoring service (SMARTHINKING Online tutoring services), although this specific online service was not mentioned by the current Learning Specialists or program administrators.

Job placement. Administrators report that most of their students in the BSET program are employed while enrolled in the BSET program, so when many of them graduate they are already employed. Because they have had so few students looking for job placement after graduation, program administrators track them anecdotally and assist them in polishing their application materials and in their job search (RE3 p. 7). There is a staff member who currently works with companies in placing students in internships, but that service is generally restricted to associate degree-seeking students because of the funding source of the position. As the BSET program grows at DSC, the hope is to create a position with funding that will allow a career services position to help both associate degree seeking students as well as the BSET students in finding jobs after graduation (RE3 p. 8). The goal to have a career services specialist functioning in the College of Technology is important to administrators at the ATC because the focus of the career services on the main campus is not on technical employment (RE3 p. 8).

Career services. Administrators of the BSET program make it clear that manufacturing jobs are available, but focusing on the hire-ability of their students is still important to ensure their graduates are getting the jobs. Faculty in the BSET program are able to help students network, but to be more competitive candidates, faculty do direct students to Career Services at DSC to develop their resume and cover letters (RE3, p. 19).

Sharing What Works: Evidence of Effectiveness and Success

Evidence offered as a demonstration of success.

Post-graduation. Anecdotal information was shared regarding student employment. Program administrators reported that job placement for most BSET students takes place before graduation. Most people are working while they are enrolled in the program. Some students change jobs along the way. However, program administrators reported that few students drop out of the program due to finding a full-time job prior to graduation. Program administrators noted that students "see the value and want the security of the degree." The BSET degree is viewed as a way to both avoid job loss and gain job mobility.

> "Here, we just graduated our first group. So it's too soon to say, however, I had two companies that already sent me their open positions and I sent that to students that I knew were qualified, so I believe they got the job. But I know that we were tracking that before, and I hope we're tracking that now. That's…a College of Technology outcome, is to make sure that the students are placed." (CM p. 8)

There did not seem to be any formal method in place to track alumni of the DSC BSET program. Due to the recent move of the program to DSC, there are so few alumni currently, that program administrators and faculty report keeping in touch with alumni through social media.

Accreditation. When asked to demonstrate program quality, program administrators point to ABET accreditation. At UCF the BSET program created a method for completing their assessment as part of their accreditation process. Rather than assigning one person the task of compiling all of the required information for ABET accreditation, the program administrators created an assessment wiki. All faculty members contributed to the online wiki. Program administrators are now implementing this protocol to complete their ABET and SACS accreditation processes at DSC. An administrator describes the benefits to completing a self-study as a group rather than assigning it to one person: "And for me, it wasn't so much about whether you could gather the information; it was about the fact that you saw where your information fit into the big picture." (RE1 p. 23) All faculty members have access to this shared document, and are able to use it to evaluate their individual course outcomes, and can also see how they fit into the larger picture of the entire program.

Faculty. To show the quality of the faculty in the BSET program, a Program administrator provided a list of all grant, conference, publication and service activity from the 10 faculty teaching in the BSET program during the 2010-2011 academic year, which included 10 grant applications, 21 conference presentations, 21 publications, and a long list of professional affiliations of current faculty members.

> So they're very productive. ... To give you an idea, this is an engineering technology department. It does not offer master's degrees. This is grant activity for one year. Publications for one year. Professional service for a year. And faculty on conference proceedings for one year. With 10 faculty members. (RE1, p. 16)

Faculty are not evaluated based on research grants, but are primarily evaluated on teaching. Program administrators report that these activities are a result of the ambitions of individual faculty members. The administrator describes these grants and publications as part of the professional development of the faculty. It is important to note that all of these 10 faculty members came from UCF when the BSET program was moved to DSC. The expectations of faculty at UCF are more research focused than DSC. The faculty did not leave this grant-applying, publishing culture behind at UCF, but brought it to DSC. Program administrators provided this fact as evidence of the quality of the faculty and the BSET program.

Descriptions of evaluation efforts.

Campus-wide assessment. University-wide assessment efforts have been implemented for academic as well as non-academic programs at DSC. Academic units are required to complete two planning cycles within a 3-year period. One cycle means they measure outcomes once, analyze the results, and then implement changes for improvement based on those results, and measure a second time to show the comparison. Campus-wide assessment efforts follow SACS requirements, which is every three years. Other accreditation entities have different requirements, for example ABET requires the BSET program to complete a self-study every 6 years. Requirements that the BSET program fulfills for ABET accreditation also satisfies the institution-wide assessment requirements. In addition to departmental requirements for institutional assessment, which are reviewed by the Academic Assessment and Planning Office, the Planning Council is also involved in assessment. The Planning Council has committees including the Academic Success Committee as well as the Instructional Review Program. The Instructional Review Program looks at programs every three years focusing on past results including student success rates,

number of completers, outcomes, their mission, faculty qualifications and course loads. The Academic Success Committee looks at individual programs every year examining specific program outcomes, as well as how current results are being used for program improvement. When the BSET program was moved from UCF to DSC, they were required to submit program outcomes and measures to SACS to approve the new degree program. One assessment coordinator on campus describes the depth of the assessment culture that already existed in the BSET program when it was moved to DSC. Many of these institution-wide assessment efforts did not require additional work for the BSET administrators (CM, p. 1-3).

Data culture. Evaluation and experimentation are described by program administrators as "a part of the day-to-day culture" (RE, 2011, p. 11) of the program. For example, during the Fall of 2012 the faculty explored a new learning strategy for intermediate algebra. One section was held for a "massive" group of 300 students in one class (most classes enroll approximately 20 students), with lectures offered over the span of two weeks. Students sat in live lecture, where attendance was taken. Based on their attendance, an assessment was opened for students online. If a student did poorly on the assessment, the student could go back to the live lecture to try to learn again. When they returned to the assessment, it is reset, as if they never had done it before, allowing for self-correction of mistakes. This set up a scenario in which there was no penalty for trying. Students would complete a total of 45 modules in 15 weeks. Moreover, with as many as 3,000 students enrolling in intermediate algebra each semester, comparison groups (i.e., traditional live classes, online classes) were readily available to test the effectiveness of this new teaching strategy. In addition to examining learning across the full course, the faculty planned to evaluate progress at a modular level to identify specific areas in which the students struggle.

Program administrators suggested that the data-driven culture was promoted by the engineering background of the faculty and administrators of the BSET program and the requirements set by the SACS and ABET accreditation processes. The creation of the assessment-wiki to make the ABET accreditation process a more inclusive effort was described as a product of the culture of the School of Engineering Technology (RE, CM).

Sharing What Works: Replicability and Usefulness to Others

What has been replicated by this site? Program administrators point to the value of NSF-ATE funding creating opportunities for higher education institutions to "go above and beyond what [they] are already doing; to do things that [they] do better" (RE, 2011, p. 13). Improvements may be found in recruitment efforts, curriculum coordination, faculty training, or other areas. Most importantly, NSF-ATE funding "supports a base population of students who wouldn't normally get support – a traditionally underserved population" and it is those students who "benefit most [as they] receive a higher quality product" from the educational institutions that they attend (RE, 2011, p. 13).

Advice to institutions considering AB degrees. One program administrator of the BSET program spoke about the challenge of teaching associate-level courses versus bachelor's-level courses, and suggested that one of the most important things for future AB programs to consider if they are coming from a primarily associate teaching background is the migration of their faculty from associate-level teaching to baccalaureate-level teaching. The administrator described the associate-level teaching as more of a step-by-step for students with some critical thinking skills addressed, but critical thinking is not stressed in the associate-level program. The associate-level faculty help students through the program, with a "hand holding" approach (RE p. 20). The struggle of having faculty teach baccalaureate-level courses after they are used to teaching in associate-level courses is getting them to abandon this "hand holding" way of teaching. Because the BSET program was moved from a primarily bachelor's degree-

granting institution to a primarily associate degree-granting institution, perhaps this clash of cultures was more evident at DSC. The administrators in the BSET program have tried to introduce the associate-level faculty to teaching techniques used by bachelor's-level faculty. For example, a requirement was instituted to require every bachelor's-level class to have an open-ended problem where the faculty member would not provide any guidance in helping students come to the solution to the problem (RE3 p. 21). This was one method used to encourage faculty to teach critical thinking skills in the baccalaureate programs.

In addition to recognizing the culture clashes that can occur when trying to transition from associate-level teaching to baccalaureate-level teaching, an administrator stressed the importance of having a network available to new programs that can help administrators guide them through curriculum development as well as the logistical requirements of a technical program such as equipment needed and lab space needed (RE3 p. 25). Having a network of support from professionals at other schools can ease the transition for a newly developed program.

LAKELAND COMMUNITY COLLEGE AND PARTNERS' APPLIED BACCALAUREATES

This section includes cases involving Lakeland Community College's Associate of Applied Science (AAS) in Biotechnology Sciences and Ursuline College's Bachelors of Arts (BA) in Biotechnology.

Lakeland Community College's Associate of Applied Science (AAS) in Biotechnology Sciences

Lakeland Community Colleges (LCC) was the first college in Ohio to be founded by a vote of local people who petitioned the Board of Commissioners to create a community college for their district. Speaking of the local community, one LCC faculty member shared, with a laugh, that "Lake County is the smallest county in Ohio, and we like to stay in Lake County" (BF, Oct 2012, p. 1). However, opportunities for higher education within the Lake County were slim prior to the development of LCC, with only one four-year college in the county – Lake Erie College, a small, private institution, established in 1856 as a female seminary and later becoming a co-educational liberal arts institution. Lake Erie College remains quite small, currently enrolling approximately 1,200 students and offering 37 undergraduate majors, and masters' degrees in business administration and education.

When LCC first opened its doors in Lake County in the fall of 1967, 1,073 students attended classes. Today, nearly 21,000 students attend classes at LCC in credit and noncredit programs, and the college offers 55 degrees, 95 certificates, and transfer modules for students looking to relocated to colleges and universities across the State of Ohio. In November 2011, opened the Holden University Center, a physical location on the LCC campus where students could complete bachelor's or graduate degrees from a variety of partnering colleges and universities. (More details regarding the Holden University Center and pathways offered to baccalaureate degrees are offered later in this section.)

Central to LCC's mission is "making higher education accessible" and "meeting the social and economic needs of the community" of Lake County, Ohio (http://lakelandcc.edu/about/, Retrieved February 27, 2013).

LCC Current Students

According to the NCES' IPEDS College Navigator, in Fall 2011, a total of 9,521 students were enrolled in undergraduate degree programs at LCC (480 of those as transfer-in undergraduate students). Of those students, 39% attend full-time and 61% attend part-time. Approximately 39% of undergraduate students are male, and 61% are female. A total of 74% of the undergraduate student body self-identified as White /Caucasian, 16% as Black or African American, 2% as Hispanic/Latino, 1% as Asian, and 1% as two or more races. Race ethnicity unknown was reported for 5% of undergraduate students. According to documents from LCC's IR office (http://lakelandcc.edu/research/EnrollmentF12.pdf, Retrieved February 23, 2013) , students ranged in age from 15 years to 86 years, averaging 28 years of age. The majority of students (98%) are in-state residents. About 60% of the students reside in Lake County, 21% in Cuyahoga County, 10% in Geauga County, and 6% in Ashtabula County. Approximately 80% of students are employed full-time or part-time while taking classes.

Again referencing the IPEDS data source, of full-time, first-time degree- or certificate-seeking students who began their studies in Fall 2008, 13% graduated and 38% transferred-out within 150% of the typical

completion time for their program. Graduation rates were slightly higher for male students (15%) than female students (11%). Graduation rates were also higher for Asian (30%) students, as opposed to their Hispanic/Latino (17%), White (16%), and Black/African American (3%) peers.

Across LCC the student-to-faculty ratio is 11:1. The IPEDS data from Fall 2011 reports 120 employed full-time faculty and 485 part-time faculty, all primarily serving in instructional roles.

University Partnership Agreements for Bachelor's Degree Attainment

In November 2011, LCC opened The Holden University Center, a "new, state-of-the-art facility" located across the street from the main LCC campus that "offers convenient access to complete a bachelor's or graduate degree from a variety of leading colleges and universities" (Holden University Center brochure, 2012). Degrees are conferred by college and university partners who bring their courses to students in physical classrooms at the Holden University Center building, online in virtual classrooms supported by LCC personnel, or in a hybrid classroom/online format. The motivation behind the Holden University Center was presented by one faculty member as "based upon responses to a survey of the community, what people want… we will keep tuition low. We will bring four-year degree opportunities to Lake County, more so than what we had done before" (BF, Oct 2012, p. 1). As tax levies continued to pass to support LCC efforts for the community, college leaders reflected "it was time for us to say, yes, we said we would do this" (BF, Oct 2012, p. 1) and to move forward to creating the university partnership agreements to make the Holden University Center idea a reality.

When the initiative began, a single partnership agreement existed between LCC and Cleveland State University (CSU) to offer baccalaureate degrees onsite in Lake County. Within two years, partnerships had been created with seven institutions to offer a total of 14 bachelor's degrees in a variety of fields, as well as a Master's of Business Administration. A mixture of strong leadership from the provost and president level, as well as "a lot of faculty involvement" (BF, Oct 2012, p. 2), facilitated the rapid growth. Participating institutions and available degrees are listed in Table 17. Once an institution has contracted to offer a particular degree program within the Holden University Center, they are guaranteed exclusivity. That particular degree program will not be offered through the Holden University Center by another institution "as long as [the relationship] remains positive [and] mutually beneficial" (BF, Oct 2012, p. 2).

All partner programs are required to be "better than a two-plus-two" in terms of the credits that are accepted from the community college. One faculty member reports with pride that "a good number of our programs are actually three plus one" (BF, Oct 2012, p. 2). For the programs that are a three plus one, students complete a two-year associate degree at LCC, followed by a year of extra courses – "we call them bridge courses more often than not" (BF, Oct 2012, p. 7) – which are often made up of general education offerings, which are then followed by a year of upper-division major offerings provided by the partnering college or university. A driving factor behind this requirement was reported to be "keeping the tuition costs reasonable" (BF, Oct 2012, p. 2). Also note that several programs are applied in nature (e.g., Bachelor of Technical and Applied Studies [BTAS] in Computer Technology, Bachelor of Science in Applied Science [BSAS] in Allied Health), however, humanities and Bachelor of Sciences programs are also present in the degree program offerings.

One of the biggest challenges experienced in the implementation of the university partnership programs has been tracking students from associate-level programs, to and through the bachelor's degree programs, in order to provide evidence of student outcomes and successes. This challenge begins with associate degree students enrolled at LCC. As one faculty member explains:

> Our internal processes do not require that a student update their current major, their current intent. So for that third year, because we probably – Our gut is that our enrollment decline this fall is less because of the students who have either come back to take those additional courses as part of a partnership agreement, or are just continuing through and weren't even a stop out. So we believe that it did. We just cannot tie a number to it. (BF, Oct 2012, p. 6)

As is demonstrated in this faculty reflection, it is challenging to follow when student degree intentions change. If students move from an associate degree program to the bridge courses within an university partnership program, without receiving the associate degree, it is difficult for LCC to recognize whether that student is a completer, stop out, or non-completer of their associate degree program. Furthermore, when a student enrolls in a university partnership program, they are technically enrolled as a student within the partner university or college (as opposed to LCC), even though they are physically located on LCC's campus. Student enrollment and progress data resides with the institution in which the student is enrolled. For LCC to gain insight into the success of their former student's progress to and through the bachelor's degree, they would need to request data sharing permissions with each partner institution. One institutional administrator shared that "We are asking [our partner universities] for data as far as how many [LCC] students are enrolled. Some are very agreeable to that, and others will just provide basically a duplicated headcount" (BF, Oct 2012, p. 7). An institutional research associate, further stressed the need to ensure that data sharing practices across institutions "won't conflict with any laws, such as FERPA, or otherwise" (KR, Oct 2012, p. 15). Despite the challenges to obtaining such data access, institutional administrators and institutional research associates alike acknowledged benefits for all institutions involved, saying that this made the investment of time and effort worthwhile to build trusting relationships and devise ways to bridge gaps between data systems to make information accessible and usable.

Table 17. Partner Institutions and Degrees Offered at LCC's Holden University Center

Institution	Degree Type		Degree Field
Cleveland State University (CSU)	Bachelor of Business Administration	BBA	General Business Administration
	Bachelor of Arts	BA	Organizational Leadership
	Bachelor of Arts	BA	Psychology
	Bachelor of Arts	BA	Public Safety Management
	Bachelor of Arts	BA	Urban Studies
Franklin University (FU)	Bachelor of Science	BS	Accounting and Forensic Accounting (double major)
Kent State University (KSU)	Bachelor of Science	BS	Education, Early Childhood Education
	Bachelor of Science	BA	Public Health
	Bachelor of Technical and Applied Studies	BTAS	Computer Technology, General Concentration
Lake Erie College (LEC)	Master of Business Administration	MBA	Master of Business Administration
The University of Akron (UA)	Bachelor of Science	BS	Nursing (RN to BSN)
Ursuline College (UC)	Bachelor of Arts	BA	Humanities
Youngstown State University (YSU)	Bachelor of Science in Applied Science	BSAS	Allied Health
	Bachelor of Science in Applied Science	BSAS	Criminal Justice
	Bachelor of Social Work	BSW	Social Work

* Based on degree programs listed on Holden University Center website (http://lakelandcc.edu/uc/degreesuc.asp, retrieved May 13, 2013)

The AAS Degree in Biotechnology Science

The AAS Degree in Biotechnology Science was established at LCC in the fall of 1997, and it was the first biotechnology degree developed in Ohio at either the associate or the bachelor's level (Bioscience Technology Program Review, 2008). The idea for the degree program was developed in discussion between the Dean of the Division of Science, Mathematics, and Health Technologies and a former college trustee and industry advisor who was the vice-president of a biotechnology corporation whose headquarters are located near the LCC campus. An initial survey of local employment needs demonstrated a workforce demand for biotechnicians, so LCC developed an advisory committee with academic representatives (e.g., Case Western Reserve University (CWRU), CSU) and industry representatives (e.g., Steris) to develop a curriculum. They visited Madison Area Technical College (MATC) in Madison, WI, which offered the country's first associate degree in biotechnology, to explore their curriculum and program design. Once a curriculum structure was in place for LCC, a program director was sought to lead the program implementation. The individual who was hired into that position and has now served in that role for over 15 years.

LCC's Biotechnology Science program aims to impact biotechnology education, the industry and the workforce, through the development of strong partnerships among educational institutions, area industry employers, and civic originations (Bioscience Technology Program Review, 2008). Providing the "useful, timely and relevant science education and training" (p. 21) to achieve these goals has required LCC to seek external funding from a variety of sources to support their efforts. They have sought funds from government organizations, including NSF ATE, research grants, donations from local industry supporters, etc., ultimately "acquiring over a million dollars worth of research or industry quality equipment" to support their program (p. 21).

Program learning goals and objectives. As reported in the 2008 Biosciences Technology Program Review, the degree program outcomes include the following. The Bioscience Technology graduate will:

1. Be well grounded in the underpinnings of scientific knowledge related to biotechnology.
2. Be able to translate biotechnology science related knowledge to practical settings.
3. Be able to design, execute and interpret biotechnology-related experiments using both basic and advanced techniques.
4. Be able to utilize communication skills, compliance to applicable rules and regulations, and good lab citizenry to integrate into a laboratory engaged in biotechnology.
5. Possess the values of an objective, honest scientist that shows an appreciation of the role of science in our daily lives. They will execute their duties with integrity and professionalism. (p. 12).

In addition to this set of global program outcomes, the Biotechnology Science Department has developed a set of student learning outcome statements and performance indicators, which serve as a foundation for their departmental assessment efforts (http://lakelandcc.edu/outcomes/pdf/SciMthHlth-Biotechnology_Science.pdf#zoom=75, retrieved May 16, 2013). These indicators are provided in Table 18.

Table 18. Biotechnology Science Department Student Learning Outcomes Statements and Performance Indicators

1. Scientific Knowledge: The Biotechnology Science graduate will possess the knowledge necessary to function as a scientist.	
Performance Indicators:	
	1a. Integrate knowledge of math and the natural sciences.
	1b. Discuss fundamental scientific processes.
	1c. Use literature publications to explore scientific topics.
2. Laboratory Applications: The Biotechnology Science graduate will be able to translate biotechnology science to laboratory applications.	
Performance Indicators:	
	2a. Apply knowledge of scientific processes to experimental protocol.
	2b. Explain the science underlying the methods and techniques.
	2c. Evaluate scientific questions and select appropriate strategies for resolution.
3. Scientific Method: The Biotechnology Science graduate will be able to apply the scientific method to biotechnology related experiments using basic and advanced techniques.	
Performance Indicators:	
	3a. Accurately execute the experiment.
	3b. Thoroughly document the results of the experiment.
	3c. Interpret the results using principles of biotechnology science.
4. Laboratory Skills: The Biotechnology Science graduate will be able to demonstrate skills necessary to function effectively in a bioscience laboratory.	
Performance Indicators:	
	4a. Demonstrate good lab citizenry as defined in the field.
	4b. Adhere to regulatory compliance standards.
	4c. Communicate clearly the knowledge (and findings) related to biotechnology science.
5. Professionalism: The Biotechnology Science graduate will be able to demonstrate skills necessary to function effectively in a bioscience laboratory.	
Performance Indicators:	
	5a. Engage in a collaborative behavior with peers and supervisors.
	5b. Demonstrate integrity through generation of thorough, accurate reports that reflect all available data.
	5c. Exhibit personal responsibility; accountability; professional characteristics.

* Student learning outcomes and performance indicators obtained from http://lakelandcc.edu/outcomes/pdf/SciMthHlth-Biotechnology_Science.pdf#zoom=75 (retrieved May 16, 2013)

Curriculum design. The program director for the Biotechnology Science degree program described how the curriculum design at LCC differed from a traditional Biology degree program. He described "the old model" of biology degree programs in the following way:

> You get your 4-year degree and then you off to try to find a job and you find that you have no marketable skills. You've never done an experiment. You've never run HPLC or electrophoresis or anything like that. You've read about it in a book and read some primary literature, so you've got the materials and methods section, plowed through that, tried to figure out exactly what they were doing, didn't really understand it because you never did it. (JD & JG, p. 9)

He is essentially describing a degree program that focuses on teaching students theory ahead of application. The LCC approach "really turned that paradigm around" (JD & JG, p. 9). As the program director explains:

> We teach the students how to do the experiments first, how to function in a lab, how to document what you're doing, how to keep a lab notebook, all of the applied stuff, and then, I'll teach the biology or biochemistry or chemistry that supports that.
>
> So if you look at Lakeland's biochemistry course, I don't make my students memorize a lot of biochemical pathways like they would at a 4-year college. … They'll forget it next week. But I spend a lot of time on nucleic acids, DNA, RNA, because that supports basically what we're doing in a lab every day, depending on where you are. Or, if we're talking about microbiology, I might be talking about micro genetics that play into mutation rates, things like that, what's happening in a flask – is that culture starting to grow?
>
> So the science backs up the application rather than teaching them the science and then going out and learning the application later in sort of a more disjointed kind of a method. If you look at our syllabus, we hit all of those topics, but in sort of a little different – you know, coming at it from a little different perspective. (JD & JG, p. 9)

Program administrators believe that the skill in application that their students develop is what draws four-year institutions to want to partner and articulate with their AAS degree program. Laboratory experiences are "modeled after the work environment" such that:

> Students are expected to work as a team to accomplish experiments by sharing the preparation, relevant procedural steps, and clean up. Students document their own experiments, analyze their results and troubleshoot when possible. (Bioscience Technology Program Review, 2008, p. 12)

Lecture components are then added to the experience to provide students with "the relevant science to understand cutting-edge techniques and experimental design" (Bioscience Technology Program Review, 2008, p. 12).

The AAS degree program in Biotechnology Sciences is "rigorous" (JD & JG, p. 24), with 56 of the 70 required credits being dedicated to science courses. If students follow the recommendations in the catalog, in their first semester, they are taking: (a) a freshman, majors-level chemistry; (b) a biotechnology lab skills course; (c) a freshman, majors-level biology; and (d) the introduction to biotechnology science course, which is a broad survey course. This is 17 hours of coursework with 3 laboratory courses. The two-course required chemistry series was described by faculty as "brutal" (JD & JG, p. 25). Students who have multiple responsibilities (e.g., school and family, school and work) are "routinely counsel[ed]… to take an extended time to complete the program [because] this is a science intensive course of study that requires a substantial time commitment both on campus and off" (Bioscience Technology Program Review, 2008, p. 10). For this reason, there is both a formal two-year and three-year curriculum plan

offered to students (see Table 19 for the two-year and three-year curriculum plans for Biotechnology Science major courses.). The curriculum is divided into a track focused on microbiology and a track on molecular biology. Those students needing more time to complete the courses may take the microbiology course first, and then return to pick up the molecular biology courses that address topics such as biochemistry, molecular separations, and recombinant DNA technology. Spreading out the curriculum in this way can have additional advantages. For example, students may find themselves able to "fit in an extra chemistry course, like an organic chemistry or a quantitative analysis, which is going to transfer to their 4-year degree" (JD & JG, p. 25). Overall, courses are designed to be "lockstep with each course being a prerequisite to the next in the series" (Bioscience Technology Program Review, 2008, p. 3). If students follow the prescribed order of courses as outlined in the curriculum plans, the new material presented in each course builds upon what was learned in previous courses (See Table 19).

Table 19. Two- and Three-Year Curriculum Plan of Biotechnology Science Major Courses

Term	Two-Year Plan Course		Three-Year Plan Course	
Fall Year **1**	Intro to Biotechnology Science	3 credits	Intro to Biotechnology Science	3 credits
	Biotechnology Science Lab Skills	5 credits	Biotechnology Science Lab Skills	5 credits
	Principles of Biology I	4 credits	Principles of Biology I	4 credits
	General Chemistry I	5 credits		
Spring Year 1	Intro to Biochemistry	4 credits	General Chemistry I	5 credits
	Microbiology	4 credits	Microbiology	4 credits
	General Chemistry II	5 credits		
Summer 1	Advanced Molecular Separations	4 credits	Applied Microbiology	3 credits
	Applied Microbiology	3 credits		
Fall Year 2	Recombinant DNA Technology	4 credits	General Chemistry II	5 credits
	Bioscience Manufacturing Processes	5 credits	Bioscience Manufacturing Processes	5 credits
Spring Year 2	Intro to Bioinformatics	1 credit	Intro to Biochemistry	4 credits
	Biotechnology Science Seminar	1 credit		
	Tissue Culture	3 credits		
	Internship	5 credits		
Summer 2			Advanced Molecular Separations	4 credits
Fall Year 3			Recombinant DNA Technology	4 credits
Spring Year 3			Intro to Bioinformatics	1 credit
			Biotechnology Science Seminar	1 credit
			Tissue Culture	3 credits
			Internship	5 credits

Enrollment and Student Demographics

The Biotechnology Science program at LCC is small, typically taking in 14 – 16 students and graduating 6 – 8 students per year. Enrollment has been limited primarily due to restrictions in laboratory space. The laboratory rooms physically hold 18 students. They advertise for 20 students to start the program, so in the beginning they "might have a couple of people sitting on the end caps" of lab tables. Yet attrition occurs and those numbers decrease as students progress through the required 70 hours of coursework.

The Biotechnology Science program has historically had about a 50% attrition rate, which is "above average for the college" (JD & JG, p. 1). The primary reasons for student attrition in this degree program have changed over the years. Up until about three years ago there was a "50/50" split between students leaving due to academic difficulty versus students leaving due to other personal reasons – "They get married. They get pregnant. Their job." (JD & JG, p. 1). But, then three years ago, the biotechnology industry in Ohio experienced a considerable economic shift. As described by the AAS degree program director:

> Three years ago, as the economy crashed, then all the stimulus money became available. And we are part of a statewide grant… of a $5 million grant to Bio Ohio…
>
> We have $100,000 left to spend on some training activities and that kind of thing. But basically no one in the program now is paying tuition. … About half of our students, or at least half of my students are on Pell grants. So Pell is enough – They get like $7,000 a year, so that's enough for our entire tuition, and then some books and travel money as well. So about half of our students are coming here basically for free. But the rest of them then, the Department of Labor is picking up their tuition. So that was a great marketing tool. We also had a marketing budget, and it brought more visibility to the program.

The available funding sparked new demand for the Biotechnology Science degree program. In the 2011-2012 school year, they over-enrolled, talking in a class of 28 students. But, something else happened along the way as well. Due to the new, high demand for the degree program, admissions officers started to pay strict attention to entrance requirements listed in the course catalog – requirements that were not checked in the past. Specifically, that students had to have a college ready math background and to complete Chemistry 1100 or high school chemistry with a "C" or better as a prerequisite course. Now, two years later, 22 students are still enrolled in the program. This is a retention rate of 79%. Additionally "no one has gone because they can't make it academically." Students who have left, have done so for personal reasons – "health reasons and things like that" (JD & JG, p. 6). This has led to some interesting insights for the program administrators. They shared that:

> [In the past] I had people coming in unprepared and people who didn't make it. It was probably a disservice to them through the years, [and we] probably should have been a little bit more tough and made sure that everybody in there was prepared and ready to go because those entrance requirements for Chemistry were a good thing to have in our first semester courses, like lab skills and such. … So it was a blessing in disguise really that we got this Department of Labor grant and put this application process in place and are now making sure that everybody is qualified. (JD & JG, p. 6)

Looking across all enrollments in the degree program (first and second years) total student enrollments have ranged from 19 students in the 2006-2007 academic year to 43 students in the 2011-2012 academic year, with an average of 29 students. Table 20 provides the enrollment numbers for each year, as reported in the Bioscience Technology Program Review (2008) and Bioscience Technology Department and Program Review (2012). Slightly more females enroll in the degree program than males each year (Bioscience Technology Program Review, 2008; Bioscience Technology Department and Program Review, 2012). In terms of ethnicity, over 80% of students have identified as White/non-Hispanic for seven of the past nine years. Program administrators report that this ethnic profile is "a microcosm of the college as a whole" (Bioscience Technology Program Review, 2008, p. 7). Enrollment patterns over the past nine years demonstrate a fairly balanced split between full-time and part-time students.

Table 20. Biotechnology Science Enrollment Data

Student Groups	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
New	9	6	9	5	9	3	5	9	7
Continuing	11	14	18	12	13	19	19	22	29
Returning	6	5	4	2	3	5	4	8	7
Total	26	25	31	19	25	27	28	39	43

The average age of students is in the range of 28 or 29 years old (which also mirrors the college as a whole, as compared to the 15 day Fall 2012 Enrollment data). Some students are 17 years old and still attending high school, while others are career-changers in their 50s and 60s who are returning to gain new skills. As described by the program director:

> I've had everyone from high school students, to mothers who had raised their family and decided to come back and learn a trade, to people with master's degrees. I even had a couple of PhDs who had worked in protein chemistry all their life and wanted to come back and learn how to clone a gene. (JD & JG, p. 1)

In fact, program administrators estimate that 30% of students who enter LCCs' Biotechnology degree program have already earned a bachelor's degree. A few of these students even come to the program with a masters or PhD degree. This happens when a local lab closes and professionals who are recently out of a job need to reskill or retool to learn new techniques in up-and-coming scientific areas. As expressed by the program director, this "enrichment" of the current workforce is another important role that LCC plays in the community – "we really wear a lot of hats here!" (JD & JG, p. 21). The high school students who come to LCC pursue their courses in lieu of their local high school classes. The result is a diverse group of students in the classroom, both in terms of age and past related experience.

The LCC advisors who assist students in the allied health programs described students in the Biotechnology Sciences degree program as follows:

> They're pretty committed students. A lot of them who come in to see us already have bachelor's degrees in biology or chemistry, and they're coming in because they need that technical skill to go out and work, and the lab skill to go out and work. So they're very good students to advise. They're on a mission; they know what they want. … Or, if they're coming in fresh out of high school, no college experience, they have to have a pretty good sense that they like science and they want to get into doing research. (DA & KMD, Oct 2012, p. 3)

These advisors had a sense that students who choose a degree pathway in Biotechnology Science were quite focused in comparison to students in other allied health fields, who might still be exploring options or unsure of their exact direction – "We don't get too many [biotechnology sciences] students that come in that are kind of wishy-washy like we do with some of the other health technologies" (DA & KMC, Oct 2012, p. 6). One allied health advisor went on to say that students who do well in the Biotechnology Sciences degree program are "just really smart students. They start in the biotechnology, but a lot of them want to go on further to get their bachelor's and apply to pre-med which, if they have a good background, they do." (AD & KMD, Oct 2012, p. 7).

On the other hand, according to the allied health advisors that we spoke with, students who struggle in the Biotechnology Sciences program tend to be those who are not academically prepared for the coursework and who "have a lot of building to do" (AD & KMD, Oct. 2012, p. &) in terms of remedial classes before they can access college level math and chemistry courses. These students have difficulty overcoming the gaps in their academic history.

Degree program faculty and administrators reflected that "in general, students that succeed in the first semester continue on to graduation" (Biotechnology Science Program Review, 2008, p. 10). This assertion is based on analysis of course-by-course grades, specifically examining courses that show high failure or withdrawal rates. This examination showed that "courses with higher failure rates and withdrawal rates are those in the first year of the program, especially the first semester" (Biotechnology Science Program Review, 2008, p. 17). Program faculty interpreted this finding, reflecting that it is in this first semester that students are introduced to the rigor of the science courses that are required for the major. Faculty perceived that if students could adapt to the challenge, and enjoy the first semester of courses, they could generally persist through the degree program. However, additional efforts were still underway to help students determine even earlier if Biotechnology Sciences was the appropriate degree program choice for them, including meetings with the program director prior to the start of classes and the development of promotional materials to help students connect with career opportunities.

Tuition and Fees. Table 21 outlines the estimated tuition and fees for the Biotechnology Sciences degree program, as reported for the 2012-2013 academic year.

Table 21. Estimated Tuition and Fees for the Biotechnology Sciences Degree Program, 2012-2013

Expense	In-State Student	Out-of-State Student
Tuition	$6,737.50	$8253.00
Books	$600.00	$600.00
Background Check	$68.00	$68.00
Application / Registration Fees	$30.00	$30.00
Supplies / Materials	$50.00	$50.00
Graduation	$40.00	$40.00
Total	$7,525.50	$9,041.00

Transfer and articulation agreements.

Building relationships. LCCs' AAS degree in Biotechnology Science has transfer articulation agreements with three bachelor's degree programs: BA/BS in Biology at CWRU, BS in Biology at CSU, and BA in Biotechnology at Ursuline College (UC). An important part of the story related to developing these articulation agreements is the relationships between faculty members and administrators at the institutions involved. For example, as expressed by the program director at LCC, having someone from CWRU on the advisory committee providing input into the development of the program at LCC was helpful when they sought to develop an articulation agreement. Faculty from CWRU "were involved from the ground up [and] knew the curriculum" (JD & JG, p. 8). There was an understanding of the need that LCC's program filled, and there was "a lot of trust" and personal investment built up over the time spent working together across institutions.

A similar situation occurred when working with CSU. The program director for LCC had graduated from the CSU program and had taught as a teaching assistant for their programs. The quality of his teaching was well-known by the faculty in the CSU department. This was complemented by similarities that could be seen on paper between the course syllabi at LCC and the syllabi at CSU for courses such as biochemistry and molecular biology. This resulted in "a built-in trust because they were invested and they knew (the program director)" (JD & JG, p. 9), which helped facilitate the process of developing an articulation agreement.

Currently, both UC and CWRU have representatives on LCC's Biotechnology Sciences Advisory Board, with a voice in programmatic changes and connections to the workforce.

Case Western Reserve University (CWRU). The articulation agreement with CWRU emerged after a report produced by BioOhio that also demonstrated an urgent need for technicians in biotechnology. A program administrator described CWRU agreement as working well because they have an "a la carte menu" bachelor's degree in Biology, meaning that there are many electives at the 100 and 300 level (JD, July 2012, p. 1). The AAS degree classes can transfer in as elective credit, which is "still meaningful elective credit" because it is related to students' degree fields and career paths (JD, July 2012, p. 1). For example, the Introduction to Biotechnology Science course at LCC does not have a lab component. As a result, it cannot be accepted as a major course at CWRU. The 2008 Bioscience Technology Program Review report shares that the transfer agreement with CWRU is particularly useful to students who "gain employment in research labs at Case" after graduating from LCC, because these students can both transfer credits and "take advantage of the tuition waiver benefit" (p. 10).

Cleveland State University (CSU). The on-paper articulation agreement between LCC and CSU exists for students to pursue a Bachelor of Science in Health Sciences. This articulation agreement was designed to provide an option for an applied baccalaureate degree pathway from a variety of health-related associate degrees offered by LCC. The program director for the Biotechnology Sciences AAS degree program, however, reported that he "never promotes" this pathway to his students because it is not a "viable pathway for our students" who do not typically take courses in Anatomy and Physiology or Medical Technology. The Biotechnology Science program, courses, and student focus is so different from other health-related programs at LCC that program administrators do not see it as a good fit for this "catch-all" health care program articulation, even though Biotechnology Sciences is included in the degrees that may transfer.

Instead of transferring to the BS in Health Sciences degree program, students from LCC's AAS degree program in Biotechnology Sciences tend to transfer to The BS degree program in Biology at CSU. The evaluation of transfer credit is done on a case-by-case basis, and students typically transfer about

one and a half years of credit earned from the 70-credit-hour AAS degree program. The LCC program administrators report that:

> The story changes with every student. So, one student, well, we're not going to accept your biochemistry. But now with the latest student they accepted our biochemistry and recombinant DNA technology as substituting for their biochemistry. … But I can't complain because everybody has received a year and a half of credit or so. I don't really care about the details. The students seem to be able to work it out. (JD, Oct. 2012, p. 3)

A graduate of the LCC AAS degree program who was nearing completion of the CSU BS degree in Biology confirmed this experience. Describing the transfer of credits, he shared that "everything transferred basically as something, [but] there's no like A equals B" (Graduate Interview, Oct 2012, p. 7). However, the process of getting courses to transfer required students to have tenacity, persistence, an understanding of "the system," and a willingness to seek help. For example, as the Lakeland graduate / CSU student described:

> One of the statistics classes I took, like I was able to bother them long enough that it eventually, the university, changed it into counting as a statistics class and a math class. So like it double counted. ...
>
> The CSU system is kind of complicated to get around because there's your biology classes and there's the general education classes, like university classes or whatever. And your online thing where it says if you completed everything, they'll say it's not completed here but it's actually completed here too.
>
> So if you didn't understand how to interpret everything, you're pretty confused. It's your own fault if you don't go and ask someone. There's enough people that can just tell you how it actually works if you sit down and actually work with them persistently.

Students who know how to navigate higher education environments and take the time to assert themselves seem to be rewarded with assistance and the approval of credits. Yet, this raises the questions regarding whether credit is awarded inconsistently across students, and how credits and student learning experiences are valued. Are certain students disadvantaged due to a lack of cultural capital regarding how to navigate higher education environments, a less confrontational or aggressive style in seeking credits, or perhaps more limited time to seek out meetings with the single advisor who is available for biology students?

It is also important to note that this experience of course equivalency decisions may change in the near future. During our site visit to CSU, the faculty mentioned that they were in the process of formalizing course equivalencies between LCC and CSU because they were seeing more transfer requests from LCC students. As the volume of transfer students using this degree pathway increased, the CSU faculty felt that it was important to ensure that credit was awarded equitably across all students and in ways that ensured that learning outcomes were adequately achieved for all courses, whether completed at LCC or CSU. [This will be addressed in more detail in the CSU case writing.]

Ursuline College (UC). The articulation agreement with UC came about through meetings of the Cleveland Growth Association's workforce development group (which, in March 2004, was consolidated into the Greater Cleveland Partnership). A workforce needs assessment by this group demonstrated that biotechnology was a high growth field in the Cleveland area, and that there was a need for more educational pathways in this field. A representative from UC was at the table for this discussion, and contacted LCC's Biotechnology Department a few days later. The UC representative expressed interest in developing a partnership that would allow them to offer a bachelor's degree in Biotechnology, through a partnership with LCC that already had the equipment, laboratories, and courses developed in this area. The degree would be designed as a 3+1 program, with students completing three years of general education, biology classes, and electives at UC followed by one year of targeted study in Biotechnology

courses at LCC. One LCC faculty member reflected that it is "very unusual for a four-year college to give up control of their major curriculum in that way" (JD, July 2012, p. 3). A 2+2 degree pathway was then created to allow LCC students to continue on to a Biotechnology bachelor's degree at UC. When asked about the number of UC students who take advantage of the 3+1 degree pathway, the response was quite small – perhaps three students in total over the years that the program has been in place. An additional 3 or 4 students were reported to have transferred from LCC to UC, using the 2+2 pathway.

Several factors are thought to contribute to the low numbers of students taking advantage of the transfer pathways available between LCC and UC. While faculty on both campuses speak highly of the opportunities, there is some question about how well they are promoted to students and how well they fit students' needs. For example, LCC's recent participation in the Community College Survey of Student Engagement revealed that, on average, their students work over 30 hours per week while attending school. Most graduates of their Biotechnology Science degree program need to pursue a job after obtaining their AAS degree. Those that chose to pursue a bachelor's degree, tend to continue to balance a class and work schedule. Doing this at UC is difficult because their Biology classes are offered as a day program and, as a private college, "their tuition is fairly high" (JD, Oct. 2012, p. 5). This makes UC a less attractive option for many students than Cleveland State University, which is less expensive and offers evening classes that offer greater flexibility to work.

Student Choices. Choosing between these higher education institutions is often related to students' life circumstances. CWRU offers tuition waiver to technicians who work in their labs. They provide up to 6 hours per semester to employees. The Cleveland Clinic offers $5000 tuition reimbursement to employees. Many biotechnology companies have tuition reimbursement programs. CSU offers classes in the evenings, offering an attractive schedule for working adults. UC has a traditional day-time class model. Graduates who choose to go to UC tend to be traditional students who are not working while they pursue their education.

Faculty Roles and Positions

The faculty composition in the Biotechnology Sciences program remained "virtually unchanged" (Biosciences Technology Program Review, 2008, p. 11) over the history of the degree program. There is one full-time faculty member, who also serves as the program director and teaches five of the eight major courses within the program. Due to the small size of the AAS degree program, there are only two part-time, adjunct professors who teach the remaining three major courses within the program. "Very high standards of employment" (Biosciences Technology Program Review, 2008, p. 11) are applied when selecting part-time faculty. Both of these faculty members hold Ph.D. degrees in relevant subject areas, and they bring industry expertise to offer a "broad background in various biotechnology applications" (JD & JG, p. 3) that those with an academic background may not have exposure to. For example, the adjunct professor who recently taught sections of the recombinant DNA technologies course had 15 years' industry experience at a national company where he was instrumental in developing enzymes for commercial use. He also had experience as a Primary Investigator, doing primary research at The Cleveland Clinic for 6 years. The advisory committee is a strong source of recommendations for potential adjunct professors. Another potential source of adjunct professors is via network that the program director has with CWRU and The Cleveland Clinic. He shared that he likes "having people on the cutting edge [and] giving postdocs a chance to get teaching experience" (JD & JG, p. 4).

The faculty members in the degree program described themselves as working very close together throughout the academic semesters – "The program is very much like a tight knit family. We have multiple lines of communication." (Biosciences Technology Program Review, 2008, p. 12). The LCC

campus provides support services to help adjunct professors develop syllabi, test questions, and teaching protocols. The program chairs "keep watch over the new part-timers as they are added" (JD & JG, p. 4), tracking course evaluations and providing assistance when needed. Adjunct faculty contracts are made on a semester-by-semester basis. One program administrator described that: "if somebody doesn't work out, usually the program chair would try to work with them and sort of give them advice, but sometimes that just doesn't work. So we move on and find people that will." (JD & JG, p. 5). That said, the 2008 Biosciences Technology Program Review reported "little turn over among the part-time faculty" (p. 11).

Future Directions

The program director and administrators at LCC see many opportunities for growth – chances to "get ahead of the growth curve" (JD & JG, p. 27) – in the Biotechnology Sciences degree program, as well as related degree programs. The limiting factor for them is space. As described by one program administrator: "we'd love to see [the biotechnology program] grow, but it's going to be a matter of funding and getting the building and the ability to expand it. … [the degree program is at] max right now with the number of seats he has, period." However, a great economic need for biotechnology scientists remains. For example, program administrators shared that:

> There's a need there for Medication Lab Technicians that also know the molecular techniques, to be able to sequence DNA, be able to use these DNA probes to look for things... We've got a technique called PCR. You know, so these are techniques that we're teaching in the biotech program, that have been research tools, that are also diagnostic tools in the medical profession
>
> You're going to need people that can do the tests, people that can manage that information. Like the Clinic was talking about, needing probably six genetic assistants, genetic counselor assistants for every genetic counselor doctor. You know, people who are going to be able to plow through this information and feed it through the decision makers in a meaningful way. So I can see the future of medicine because I'm working with Cleveland Clinic on just cutting edge stuff, and I'm thinking Lakeland can ride that crest, Lakeland can be a leader in this because we have the infrastructure, we have the biotechnology program, where other community colleges here in northeastern Ohio do not. We have an opportunity… we were talking about space. I'm an advocate for – I think we need a science building.

Barriers and Challenges

Communication with counselors. One of the challenges that the AAS degree in Biotechnology Science experienced in its early years was working against some conflicting messages shared by the Counseling Services office on LCC's own campus. The AAS degree program director stressed that:

> I had a hard time really getting across to our counselors the opportunities that we have in what I do. I got to the point where a couple of years in a row, on the first day of class, people were coming to me and saying, "Counselor told me there are no jobs in this field and that the credits don't transfer and that it was a difficult program. So why would you go through this difficult program when the credits aren't going to transfer, there's no jobs in it?" So they're cutting me off at the knees here!

This was particularly distressing to the program director since he could demonstrate a 100% placement rate from the degree program since 2003, despite the economic downturn. There was some sense that communication with counselors about opportunities in Biotechnology had improved since the receipt of the Bio Ohio grant funding in 2011-2012, especially due to the program marketing that was a part of that grant. There was some hope expressed that perhaps the messages were changing.

Meaningful college credit. Program faculty at LCC stressed the need to "make the system better" for Tech Prep and Career and Technical Education (CTE) students. A number of their students have started and stopped other programs before settling into the Biotechnology Sciences program. By the time these students get to Biotechnology, they are running out of financial aid and have difficulty finishing the 70 credit hour program. While there is value in Tech Prep Boards working to get students college credit, this faculty member warns against awarding "empty college credit" that may "chew up financial aid" (JD, July 2012, p. 4). These concerns were echoed in reflections shared by an institutional research associate who spoke of data she had run regarding LCC students and credit hour completions. She shared that:

> Most of our degrees are 60 to 70ish credit hours. If I take a look at students and credit-hour completions. There are students who have 100+ hours that still don't have all the requirements for a specific associate degree. It speaks volumes to the type of student who ends up here, especially immediately after those that are either new from high school, or new delayed from high school that are here to find their way in academics, whether that's through working through how to be successful in academics, or whether that's "I don't know what I'm interested in." They take a wide variety of courses and meander through coursework from path, to path, to path, to path, based on interests alone. We have that, just like any other community college does. Certainly four year institutions have that too, but I certainly don't think to the extent that community colleges do. (KR, Oct 2012, p. 14)

In the long run, improvements are necessary across the system to award college credit, but also to ensure that it counts toward a degree. Furthermore, the Biotechnology Sciences program director commented on the college completion push, particularly with a focus on attaining bachelor's degrees. While the need to increase college completion is palpable, he stresses that this must be done "without decreasing the quality of degrees" (JD, July 2012, p. 4).

Community colleges playing multiple roles. The Biotechnology Sciences program director also shared interesting commentary about needing to "walk a tightrope" (JD & JG, p. 10) between partnerships, with high school and tech prep partners on one side and four-year colleges and universities on the other side. On the one hand, there is a desire to collaborate with high school and tech prep programs – to "appease" (JD & JG, p. 10) their needs by offering college credit for participation in tech prep courses. However, they must also be ever "mindful of what [their] four-year partners are going to think" (JD & JG, p. 10). Some colleges and universities, particularly those that are private institutions "want no part of giving high school kids credit for high school classes" (JD & JG, p. 10). As a result, the Biotechnology Science faculty and administrators find themselves in a place where they need to "keep quality up" and to be "a little bit defensive about [their] curriculum" while being cautious not to offend any of their partner institutions or departments (JD & JG, p. 10). It is a challenging balancing act.

Barriers to articulation. Finally, LCC also has first-hand experience being "on the receiving end" of discriminating views of transferring applied associate degrees. The example shared came from efforts related to a state initiative called "Choose Ohio First." There was a concern in the state that too many high-achieving students were leaving the state, resulting in a "brain drain," and efforts needed to be made to keep people in-state. Choose Ohio First Grants were awarded to institutions to develop pathways to keep students in-state, and Kent State University approached LCC to submit a proposal to work together within a consortium. Not long after the grant was secured, LCC identified the first student who wanted to make the transfer and the question of articulating credits arose. While Kent State would award credit for the general education courses, "they absolutely would not even consider our technical courses." The message given to LCC faculty was "that [they were] okay at the community college teaching freshman-level courses, but [Lakeland faculty] can't possibly teach the upper level courses the way [Kent State faculty] can" (JD & JG, p. 10). This created a situation where students would lose a considerable amount of credit during transfer, extending the time and financial commitments required to obtain a bachelor's degree.

The degree models at CWRU and CSU avoid the difficulty experienced with Kent State University because they offer "an a la carte kind of a degree where [students] have to take 100-level and 300-level electives" (JD & JG, p. 10). This degree style allows students "flexibility within the degree to be a pre-med major or a microbiology major or whatever their interests are" (JD & JG, p. 10) – or in the case of LCC students, to have a specialization area in Biotechnology Sciences. They are "more flexible degree where they can take our [LCC's] courses and count them towards graduation in a meaningful way" (JD & JG, p. 17). Some four-year degree program models fit well with what LCC offers. Other program models and philosophies toward the transfer of applied associate degrees are not a good fit for what LCC offers, and are likely to present too many barriers to establish strong transfer pathways or relationships for students.

Requirements by credential. The program director for Biotechnology Sciences shared insights about recent struggles getting associate degree students and graduates placed into internships and jobs due to the value placed on the credential itself. In the past, he was able to use networking contacts to seek available positions. For example, he described his experiences networking with CWRU:

> I had had a network because I was a post doc there. So, early on I started placing students there, through the backyard, because I knew people and I had a limited number of people that I needed to place. You know, "Hey, D____, do you want a student? And, S_____, do you want a student?" And, they hired them as Research Assistant I's.

However, a change in the human resources leadership approximately 4 – 5 years ago created a new hurdle. Research Assistant I positions would now require a bachelor's degree, while those with associate degrees could apply to Lab Assistant I, II, or III positions. The program director was reassured that the change was minimal – "It's just a title. Don't worry. You still get the same benefits, the pay is pretty equivalent." (JD & JG, p. 19). In reality, however, the impact was much greater. When laboratories advertised for a Research Assistant I, now LCC students were no longer eligible – even when they had worked in Research Assistant I positions in the past. As described by the program director, he had associate degree graduates who could demonstrate:

> I've got over 50 publications; 10 are primary, first authorships, which is pretty impressive. But those people, if PI-x loses funding, can't go to PI-y, because there's now an internal block that they cannot be hired in another lab as an RA one because they don't have a bachelor's degree. (JD & JG, p. 19)

The program director spent several years working with his advisory committee member at CWRU to address the problem. Ultimately, the problem was not addressed until "the PIs revolted" (JD & JG, p. 19) on LCC's behalf. Essentially, the CWRU Principle Investigators went to their own human resources department to express that

> [Lakeland Community College] students are better than our own Case students because these guys have spent 2 years training to be a lab technician, and they come in and hit the ground running. And our students are the more classically trained, pre-meds. So, of course, [Lakeland Community College] students are going to function in a lab better because [they] spent 2 years training them to work in a lab. … Case isn't growing lab techs; they're growing doctors. (JD & JG, p. 19)

For a brief period of time CWRU advertisements were changed to say "Research Assistant I: bachelor's degree or associate degree like Lakeland." Now it is something more generic like: " an applied associate degree in biotechnology" (JD & JG, p. 19).

However, the struggle to encourage employers to understand the value of the applied associated degree is ongoing and must be repeated on many fronts. For example, program administrators shared that human

resource representatives at the Cleveland Clinic, a key biotechnology employer in the local area, could be "very degree snobbish" and "will boot you if you don't have a bachelor's degree" (JD, Oct 2012, p. 1). Occasionally, LCC faculty are able to connect their students to opportunities through networking contacts with lab directors or chairs who acknowledge the quality of students that come out of the Lakeland Biotechnology Sciences program. However, students who graduate from the degree program still report that, on their own, they "apply for a number of jobs and [keep] getting turned down because of my degree" (JD, Oct 2012, p. 1).

Program administrators shared that lab directors who are advocates of the Lakeland AAS degree program understand the value of hiring associate degree technicians, saying: "if we hire people with Master's degrees in tech positions, they are not going to be here very long. If we hire people with an applied associates degree, they're probably going to be here" (JD, Oct 2012, p. 2). Yet, it appears that there remains a gap between this understanding that is communicated by lab directors to program faculty and what seems to be occurring in hiring practices.

Sharing What Works: Program Quality

Adherence to recognized standards. "There is currently no licensure, certification or registry for bioscience technicians" (Bioscience Technology Program Review, 2008, p. 11). In the early years, shortly after the AAS degree program in Biotechnology Science was established, the faculty found that there was much discussion across institutions in their field about national standards for Biotechnology. However, defining national standards has proven to be an extreme challenge because academic programs are often "tailored to the local niche," and little consistency is found from one program to another (JD, July 2012, p. 2). For example, the LCC degree program caters to a local economy that is focused on research and development, with graduates going to work at organizations such as Case Western Reserve University, The Cleveland Clinic, and Steris, and other independent companies. However, North Central State, a public two-year college in Mansfield, Ohio, has very few research laboratories located near them. Instead, they are located near a large toxicology testing facility. To address this local need, Ashland has developed "one of only six toxicology programs in the nation" (JD & JG, p. 13). As viewed by the program director for Biotechnology Sciences at LCC, "all of these bio tech programs have grown up in the local economy and tailored their needs for that. So, it's really hard to drill down to core competencies [across biotechnology] when the programs are so diverse." (JD & JG, p. 13).

In fact, it may not be possible to create a single set of standards for biotechology – "there is just too much variation" (JD, July 2012, p. 2). Despite the best of intentions and good reasoning for desiring standardized programs – for example, so that students in Career and Technical Education (CTE) programs can get credit for courses if they choose to pursue further education – the "sense of resistance" that has stymied past standardization efforts is also understandable. On the one hand, there is an expression of concern for quality and the fit of material learned between education pathways. On the other hand, program administrators expressed that the "essence of a community college" is that "we are light on our feet, we can change quickly" (JD, July 2012, p. 3) to respond to the needs of new industries and the development of new technologies. If accrediting boards force the creation of standards on the biotechnology field, it could restrict the ability of educational programs to nimbly respond to their environments. There is a notable push-and-pull of concerns on this issue.

The question of standardization and standards creation continues to emerge, and is likely to do so for years to come – "there's always going to be an undercurrent" (JD & JG, p. 14). For example, the Department of Labor recently awarded a $15 million grant to a group who is "going to try to develop industry standards for maybe various groups" (JD & JG, p. 14). The difficulty with movements such as

these, as expressed by the program director for the Biotechnology Sciences degree program at LCC, is that the effort is being led by academics without expressed need from employers. He shares that:

> I would think that if it was necessary, industry would drive it. The consumer would drive it. The companies, the research facilities, whoever, would say people aren't being trained in the right things; we need to put together these core standards and competencies so that when I hire somebody with a degree, I know what I'm getting. But that's not where it's coming from. It's more coming from the educators and the professionals. And industry hates that.
>
> We have a group here in manufacturing that they put together called the Alliance for Working Together, and they came up with a manufacturing degree over in the engineering field, but it's fully supported by industry because they're invested and they developed it. Often times industry folks hate it when the academics tell them what they need, rather than the other way around. So that's my opinion. (JD & JG, p. 14)

The program director suggested that our research team's difficulty in uncovering biotechnology programs that transfer all or nearly all AAS credits into a bachelor's degree is related to this issue of program specialization – many biotechnology niches simply do not fit well with traditional biology bachelor's degrees. LCC's courses just happen to be a more natural fit with the four-year biology degree, whereas other more specialize programs are not able to bridge that gap.

Collaborations to Strengthen Quality and Effectiveness.

Advisory committee. The Biotechnology Science program is guided by an advisory committee that meets at least one time per year to discuss topics such as program updates, enrollment, and curriculum changes. The advisory committee is made up of representatives from both academic partners (CWRU, CSU, UC, The Cleveland Clinic) and local industry (e.g., BioEnterprize, BioOhio, Nortech, Steris). According to program administrators, "the cross-section of biotechnology experts lends breadth to program oversight and curricular guidance" (Bioscience Technology Program Review, 2008, p. 12). Additionally, the selection of individuals for these advisory committee roles is important. The program director stressed the importance of bringing in "powerful and knowledgeable" (JD & JG, p.8) individuals – senior scientists, department chairs, and decision makers. These are the individuals who "knew what the local needs were; they knew what the curriculum should encompass" (JD & JG, p.8), and they can provide the best input regarding future directions for the Biotechnology Science degree program.

Industry advisors. Industry advisors are viewed as key contributors to the health of the degree program for a number of roles they play. Industry advisors are sought out as a resource for "identifying industry trends and education gaps" that may be addressed within courses that are a part of LCC's degree program. Industry advisors are also viewed as a source of external funding to "promote development of short courses and workshops to promote training activities (Bioscience Technology Program Review, 2008, p. 3), as well as a source of equipment and reagent donations to keep laboratories well-furnished to help students achieve learning goals. Industry advisors are also sought out as networking resources for internship placements, which can be of mutual benefit when employers are seeking to try out potential candidates for future full-time positions.

Partnerships with higher education institutions. The partnership between LCC and UC began with an interest in pooling resources – a bit of a different focus than the other partnerships in this case. UC recognized biotechnology as a growth area based on involvement in the Cleveland Growth Association Committee. They wanted to develop a program, but did not have the resources and equipment to do so. LCC, who was also in attendance at this meeting, had "over a million dollars of equipment" (JD & JG, p. 11) obtained through grants from the NSF and the Department of Labor (DOL). They also had industry

support, donated equipment and reagents, and a well-developed curriculum. Representatives from UC recognized the strengths of the program that LCC had to offer. Representatives from LCC also recognized the opportunity to build additional high-quality baccalaureate degree pathways for their students to continue their education at UC.

As this partnership as grown over time, LCC has come to view the articulation agreements with their four-year partner institutions as a way to demonstrate the value and quality of their degree program. The acceptance of all, or nearly all, of the credits from their applied associate degree toward bachelor's degrees at well-regarded four-year institutions is affirmation of the quality of the educational experiences that LCC offers. This assertion is evidenced in the 2008 Program Review document for the degree program, which states: "Through a unique articulation agreement with Ursuline College we have extramural affirmation of the worth of the program courses" (p. 3).

Professional and community involvement.

Community outreach. LCC hosts a "free college day," which is an annual event to allow community members to come to campus to engage in a variety of mini-class sessions to "get a flavor of what [LCC] offers." Institutional administrators reflected that this event is an important way to recognize and support their community, saying: "We are funded by our local taxpayers here in Lakeland County. We are cognizant of that and want to give back to them." During the past two "free college days," the Biotechnology Sciences departments have hosted open house events so that community members could visit the laboratories and learn about both the degree program and job opportunities in this field.

Sharing What Works: Educational Significance

Instructional pedagogy.

Engaging students at various skill levels. Despite the great diversity of age and educational backgrounds that students bring to the classroom, "everybody is treated the same. Everybody is graded the same" (JD & JG, p. 2). Much of the laboratory experiences are conducted in small groups, so having the diversity of experiences can be helpful because "people that have a little more experience can kind of be a group leader" and those who are shy or uncertain about how to make the calculations can learn from other students' modeling. (JD & JG, p. 2). However, at the end of the day, all students get the opportunity to enhance their teamwork and communication skills. As described by the program director, "You've got to fit in and communicate, communicate with your PI and communicate with the people that may be below… You just can't live in a bubble, so we try to develop that teamwork atmosphere" (JD & JG, p. 2).

Applied and hands-on learning. The program director described how LCC's laboratory experience is different than what students would find at a typical four-year college or university. In this degree program, the experience is very hands-on. Students are expected to be engaged in every step of the process:

> [Students] have to make their own reagents, so they don't come here with the reagents already made for them. If we're doing something that's maybe kit-based, then they have to read the protocol, do the protocol, you know, get everything ready. So I (the instructor) do very little preparation. And then, in the end, they have to wash their own glassware, put everything away, keep up on inventory. (JD & JG, p. 2)

Further, students keep a lab journal, conduct their own experiments, and analyze their own results. The laboratory experiences are structured in this way for two reasons. First, students have the opportunity to fully understand all aspects of the work that they are doing (rather than having a reagent prepared for them, they have the experience of going through protocol to prepare the reagent). Second, students learn the laboratory techniques and etiquette that will be expected of them in the workplace:

> It's just like you're at work. They're typically not going to get the detailed information about what we're going to do tomorrow. Usually it's we need to grow up this plasmid and isolate this DNA. And here's the protocol sheet that Mary used last year. So on the computer, you'll look it up and we're going to do it today. So I try to develop that sort of be able to think on your feet, be able to understand the directions. Take directions and work. (JD & JG, pp. 2-3)

Finally, students integrate an array of sources for their reference and research, including online texts, primary literature, podcasts, and informational websites. As described by program faculty, "there is no compulsive following of a single text. Students must take the initiative to gain full understanding by utilizing multiple media" (Bioscience Technology Program Review, 2008, p. 13). This approach is expected to encourage students to take personal responsibility for their learning, and to mimic learning environments in the workforce.

Skill development. The 2008 Bioscience Technology Program Review detailed a number of strategies for helping students achieve specific skills related to the LCC institutional learning outcomes. For example, the problem-based learning approach of laboratory work is described as teaching *critical thinking skills*, as students as they identify experimental design options, perform tasks, and evaluate results. *Communication skills* are taught in a variety of ways, including: (a) laboratory notebooks used to document and communicate experiment purposes, methodologies employed, study results, and forthcoming analysis; (b) a seminar course in which students must give a technology-supported verbal presentation of the biotechnology topic of their choice, along with weekly meetings to discuss their internship experience, and (c) a speech course that is part of the general education requirements. Students are also taught to *research and seek information* in a one-semester hour bioinformatics course which includes database searches on the National Center for Biotechnology Information site. Finally, topics related to *diversity and interacting in diverse environments* are addressed in general education courses, as well as in a two-week session at the end of the Introduction to Bioscience Technology course which is dedicated to bioethics.

Internships. At LCC, all students in the AAS degree program are placed into internships that help them build connections to the workforce. The internship is the last class that students complete. All internships are unpaid, and "the college has always been adamant that they be unpaid" (JD & JG, p. 22). Experiential learning across the college, in nursing, dental hygiene, and other majors do not begin paid, so biotechnology should not be any different. Furthermore, since internship is a for-credit course, students essentially are "paying for the experience" (JD & JG, p. 23).

In preparation for internships, students are provided with a physical tour of at least one academic and at least one industry biotechnology laboratory. They discuss the differences between academic and industry environments with LCC faculty. For example, academic environments offer more flexible starting times and schedules, and greater variety in your day than industry environments. However, industry environments offer higher pay and more room for advancement, particularly without attaining advanced academic degrees. Students are then given an opportunity to express their interest in a laboratory type, and efforts are made to place them accordingly.

The time dedicated to internship is approximately 400 hours. Students attend their internships over an 8 or 10-week period, roughly full-time extending from spring break to the end of the spring semester. By the end of their internship experience, students are expected to work independently on a project. This interested in having students gain significant, practical experience is cited as additional justification for wanting internships to be unpaid experiences. Program administrators shared:

> The other reason why the advisory committee made [internships] unpaid is because they didn't want them to be slave labor glassware washers. "We're paying you, so go sweep the floor." It's supposed to be a learning experience, so when I set them up, I make sure that they understand that the student should be working independently. (JD & JG, p. 23)

Students have two years of coursework and laboratory training behind them, and are expected to be able to "quickly adapt" (JD & JG, p. 23) to the environment of any laboratory that they are placed within. As the Biotechnology Sciences degree program enrollments get larger, the program director worries that the internship placement becomes more challenging because it gets beyond the limitations of his own personal network. With 22 students to place this year, he is now "feeling like I'm going to lose a little control here" (JD & JG, p. 22), and he needs to rely on the backing of their human resources support team. As he does this, the process becomes more formal, and he has to "take the good with the bad" (JD & JG, p. 22).

Supports provided to help students achieve positive results and outcomes.

Advising and counseling. Students at LCC have access to a team of advisors who specifically serve the allied health programs. These advisors work with students throughout their programs – "prerequisites, entrance requirements, requirements for the program, and then getting them ready to move onto the next step, whatever that might be… [including] academic, career, personal, educational, crisis. It's all part of the job." (DA & KMD, Oct 2012, p. 1). In many health technologies studies degree areas (i.e., dental hygene, health information management technology, histology, medical laboratory technology, nursing, radiology, respiratory therapy, surgical technology) students are required to complete a mandatory information session prior to meeting with a counselor. However, due to the unique nature of the Biotechnology Sciences degree program – considering the degree requirements, the small size of the program, and the focused nature of the students entering the program – counselors meet with these students on a one-on-one basis.

First meetings between students and counselors often begin with a new student checklist to ensure that students are aware of the information and important deadlines that are necessary to a successful experience at LCC. Topics covered on this checklist and in these conversations include:

- applications for admission;
- submitting proper high school and transfer transcripts to Admissions;
- establishing and accessing Lakeland student email accounts
- completing the COMPASS test, if applicable
- completing a criminal background check, which is required by many health professions
- scheduling a student success information session if required based on COMPASS placement test scores
- scheduling an new student orientation;
- contacting Financial Aid for assistance completing the FASFA, scholarship, and any applicable loan forms;
- discussing course selections and registering for classes
- paying tuition and fees by the due date
- obtaining a Lakeland identification card
- purchasing textbooks and supplies
- attending classes
- receiving information on other support services across campus (e.g., computer access on campus, child care, disability resources, tutors via the learning center, veteran's affairs office)

Students who are interested in pursuing the Biotechnology Sciences degree program are required to complete a "Biotechnology Program Student Contact Sheet" in which they sign an "Acknowledgement of Student Responsibility" which states:

> I understand I am required to meet with [the Biotechnology program director] prior to starting the Biotechnology program for academic advising. I understand I **must** obtain an official application to the Biotechnology program from [the Biotechnology program director] after my prerequisites are complete.

This signed form is completed in the counseling office, and copies are distributed between the counselor, student, and biotechnology division. Students also receive a form outlining the mandatory requirements for admission into the Biotechnology Science program, which include:

- a minimum 2.0 GPA at LCC;
- completion of high school chemistry with a grade of a "C" or better, or successful completion of Chemistry 1100 (Elementary Chemistry) at LCC;
- placement into Math 1650 (College Algebra) or successful completion of Math 0950 (Intermediate Algebra) at LCC;
- successful completion of ITIS 1000 (Introduction to Personal Computers) or successful completion of credit by exam for this course;
- completed academic advising meeting with the biotechnology science program director and received approval to acceptance into the program, as indicated by the program director's signature;
- official copy of high school transcript with the graduation date, or copy of GED, submitted to the LCC Admissions Office; and
- college transcripts from other institutions attended submitted to the LCC Admissions Office, if applicable.

In addition to meeting with counselor and the Biotechnology Sciences program director, students may stay abreast of their progress toward graduation with the use of the "Degree Tracking Center," a system that allows them to see which classes they have completed, required classes for their degree, and a schedule of when classes will be offered.

Another area in which the allied health advising team provides considerable information to students regards the process for criminal background checks, which are required for all students. Because all allied health programs, including Biotechnology Sciences, "require students to complete clinical assignments and training at clinical sites" and many agencies, hospitals, and clinical facilities that partner with LCC require both criminal background checks and drug screenings, the college strives to be up-front with students about these requirements and the cost associated with them. For example, criminal background checks cost $68.00. Students are responsible for covering this cost, and fees are non-refundable. A criminal background check is valid for one calendar year. Criminal records or positive drug screenings can create barriers for students, preventing them from access to necessary work experiences to complete their degree, as well as limiting employment opportunities after completing a degree. LCC advisors expressed that early background checks could provide students with information to steer them away from incurring considerable educational costs toward degrees they would not be able to finish or use professionally. Alternatively, students may be able to discover errors in their background checks early or to identify old convictions that are eligible to be purged from their record. If this is the case, students can take care of these issues early, so their career progress is not inhibited when they get to the point of pursuing clinical appointments, internships, or employment after graduation.

Dedicated faculty. Beyond advising provided by campus-wide advising staff, Biotechnology Sciences students also receive focused guidance from the program director. During our site visit, we heard about the depth of this advising from a variety of sources. For example, the allied health advisors discussed how much they appreciated the ability to refer students to the Biotechnology Sciences program director for advising, and to trust that students will receive detailed and accurate information. This is especially necessary because Biotechnology Sciences is a small program with "very organized" students who are "on top of their field" (DA &KMD, Oct. 2012, p. 6). The allied health advisors, who serve a wide array of students, cannot be expected to maintain a detailed understanding of every field they serve. Yet, involved faculty can serve students well as a connection to exploring a particular degree field, as well as future options in the workforce and further education. One allied health advisor shared that:

> [The Biotechnology Sciences program director] is wonderful because he does a lot of the academic advising in terms of the technical side because his program is so technical with the terminology. And we're very limited, in terms of how much we can tell the students what a typical day is going to be like in [the Biotechnology Sciences] program. We're just limited.
>
> [But, the Biotechnology Sciences program director] is a scientist, and he talks that scientific information, and he shows [students] around. They're going to know right then and there if it's the right program for them or not. (DA & KMD, Oct 2012, pp. 2, 7)

One graduate of the Biotechnology Science program that we spoke with echoed this sentiment, stating that the "smaller class sizes, [and] direct contact with [the program director] constantly" were notable benefits of the degree program. This student had previously been enrolled in traditional BS degree program in Biology at a large public institution, but left the program when he lost interests because he could not see the practical application and direct career path. The personal guidance from faculty, as well as hands-on on application with "machinery and technology" (Graduate Interview, Oct 2012, p. 3) gave this student a "solid core" understanding of the science "plus these things were being applied to more current topics" which gave meaning and context to motivate his interest and progression through the material. With this foundation, he was able to return to a four-year institution environment. When we spoke to him, he was one class short of completing his bachelor's degree.

Sharing What Works: Evidence of Effectiveness and Success

Challenges to demonstrating evidence of success. One of the challenges that came up in discussions with LCC was the small size of the Biotechnology Sciences degree program. The program size is limited due to the physical space of the laboratories. With such small number of students, it is difficult to track trends, for instance between student enrollment and graduation patterns, particularly in relation to demographic breakdowns. Additionally, with articulation relationships with bachelor degree programs at three four-year institutions, and not every LCC graduate choosing to pursue a bachelor's degree directly following their associate degree graduation, the flow of students using the available applied baccalaureate degree pathways is quite limited. This makes it difficult to track outcomes on a scale that is more than anecdotal.

Another data-related challenge has to do with the multiple intentions or goals that students bring with them to community colleges. As described by one institution research associate:

> We have some very loyal students that absolutely love Lakeland and finish associate degrees years and years ago and still take courses here. We have a high percentage of students that, after they have graduated with a certificate or a degree, at some point in time either continue or come back for additional education here at the institution, whether that is on the job training, personal interest

courses, or to work towards additional certificates or associates degrees. We have students that have completed three different associate degrees.

So, you know, whatever they want to do, we are here to serve them. But, sometimes it is difficult to identify all of their different goals. (KR, Oct 2012, p. 11).

This difficulty in identifying multiple goals is spurred by a number of factors. On the one hand, there is a limitation in the technology system that LCC currently has in place – "our system only allows one major to be identified in any given snapshot in time" (KR, Oct 2012, p. 11). This provides a limitation in being able to accurately represent a student's intentions if they desire to pursue a certificate, followed by an associate degree, or two associate degrees at the same time, or perhaps if they would like to pursue an associate degree, followed by a bachelor's degree offered through one of the university partnership programs at the Holden University Center. There is currently no way to record these plans in the institutional databases. A second challenge shared by an institutional research associate is that when students are asked about their higher education goals, they have a tendency to only report their highest goal. She reflected:

If their highest goal is to get a bachelor's degree, and they are using [LCC] as a stepping stone, regardless of if they want the piece of paper or they want to be considered in that transfer module, they will tell you that they are here to obtain courses for transfer.

If they are here to obtain an associate degree, and complete coursework as it relates to certificates along the way, usually they are not going to tell you about the certificates that they are working towards or the courses that they are taking that correlate with certificate work. They will tell you what associate degree they are here for …

What happens is that with all the students putting preference towards the higher goal, we don't often get majors and certificate programs and it doesn't reflect what the actual enrollments in classes are, and what numbers are actually going through that program. (KR, Oct 2012, p.

This is a particular challenge when it comes to calculating the number of students who have completed a degree program. The institutional research associate goes on to explain:

If students don't feel like it is important or pertinent to have a certificate or piece of paper to get a job in that particular area, they won't file for completion even if they finished all the requirements for that given degree or certificate. If we don't have them as a "completer" because they didn't file the paperwork it becomes much more difficult for us to identify the students who have completed a program.

This may be further complicated by the fee, in addition to the paperwork, that is associated with filing for completion and graduation. This fee ranges between $15.00 for certificates and $40.00 for associate degrees, depending on the program (and first time graduates who fill out a graduate satisfaction survey can receive a $5.00 discount). These fees may be viewed as barriers by some students. Whether or not these fees are a contributing factor, the institutional research associate shared that when they communicate completion numbers back to academic departments, they often hear of additional students that departments would like to count as completers for accreditation purposes because they are known to have completed all of the coursework, even if they have not filed for graduation.

Evidence offered as a demonstration of success.

Annual outcomes assessment results. As a part of the Department and Program Review (DAPR, discussed in detail in the next section) program, the Biotechnology Sciences department conducts annual

assessments of a subset of student learning outcomes. They shared a summary of findings from the 2011-2012 assessment cycle in which outcomes related to students':

- Applying the *scientific method* to biotechnology related experiments using basic and advance techniques;
- Demonstrating necessary *laboratory skills* to function effectively in a bioscience laboratory; and
- Demonstrating *professionalism* in their role as a scientist.

These outcomes were further divided into observable behaviors (also known as "performance indicators") and examined via two assessment methods. Some performance indicators were examined using a direct measure of a rubric to review student artifacts, while others were examined using an indirect measure of a survey to gather information on performance at internship sites.
All performance indicators associated with the outcome of *applying the scientific method* were evaluated via an examination of student artifacts with a rubric. To accomplish this, one laboratory report was selected from every students' lab manual in their final laboratory course to be reviewed by program faculty to assess for attainment of the learning outcomes. Table 22 provides an overview of the evaluation results. When target goals were not met, program faculty offered recommendations for both improving the assessment process and educational experiences for students.

Table 22. Scientific Method Outcomes Evaluation Based on Rubric Ratings of Student Artifacts

Performance Indicator	Acceptable Target	Ideal Target	Findings Summary	Results
Accurately execute the experiment.	80% of students will achieve a 2 or 3 on the rubric.	90% of students will demonstrate competency; 2 or 3 on the rubric.	87.5% of the student evaluations were in the 2 or 3 range	Acceptable Target: Met Ideal Target: Approaching
Thoroughly document the results of the experiment.	80% of students will achieve a 2 or 3 on the rubric.	100% of students will demonstrate competency; 2 or 3 on the rubric.	100% of the student evaluations were in the 2 or 3 range	Acceptable Target: Exceeded Ideal Target: Exceeded
Interpret the results using principles of biotechnology science.	80% of students will achieve a 2 or 3 on the rubric.	100% of students will demonstrate competency; 2 or 3 on the rubric.	44% of the student evaluations were in the 2 or 3 range	Acceptable Target: Not met Ideal Target: Moving Away

Performance indicators associated with the outcomes of *demonstrating the necessary laboratory skills* and *demonstrating professionalism* were evaluated via an internship evaluation survey. The last class that LCC students complete in the Biotechnology Sciences degree program is an unpaid 8-10 week internship experience in the field. Employers completed "an evaluation of the student's ability which is returned to the school." Table 23 provides examples of the aggregate results of these survey responses. In this case, all target goals were met or exceeded and, therefore, no recommendations for improvement were made.

Table 23. Laboratory Skills and Professionalism Outcomes Evaluation Based on Employer Internship Evaluation Surveys

Performance Indicator	Acceptable Target	Ideal Target	Findings Summary	Results
Laboratory Skills				
Demonstrate good lab citizenry as defined in the field.	80% of students will receive a satisfactory in the "good lab citizenry" evaluation categories	100% of students will receive satisfactory in the "good lab citizenry" evaluation categories.	100% of the students received a satisfactory evaluation in this category.	Acceptable Target: Exceeded Ideal Target: Exceeded
Communicate clearly the knowledge (and findings) related to biotechnology science.	80% of students will receive a satisfactory in the communication categories	100% of students will receive satisfactory in the communication categories.	88% of the students received a satisfactory evaluation in this category.	Acceptable Target: Exceeded Ideal Target: Approaching
Professionalism				
Engaging in a collaborative behavior with peers and superiors.	80% of students will receive a satisfactory in the collaborative behavior categories	100% of students will receive satisfactory in the collaborative behavior categories.	88% of the students received a satisfactory evaluation in this category.	Acceptable Target: Exceeded Ideal Target: Exceeded
Exhibit personal responsibility, accountability, professional characteristics.	80% of students will receive a satisfactory in the personal responsibility, accountability, professional characteristics categories	100% of students will receive satisfactory in the personal responsibility, accountability, professional characteristics categories.	88% of the students received a satisfactory evaluation in this category.	Acceptable Target: Exceeded Ideal Target: Approaching

Further Education. Program administrators report that very few students treat the AAS in Biotechnology at LCC as a terminal degree. Approximately 80% of their students go on to pursue a bachelor's degree, and a few even go on to medical school. What contributes to this high continued education rate? The program director for Biotechnology Sciences suggests several contributing factors. On the one hand, there are the persona characteristics and attributes of the people who are attracted to the field – students who are "interested in science and have a thirst for knowledge" and therefore, "the type of student that enters the program, is one that probably isn't satisfied with ending their knowledge there" (JD

& JG, p. 17). Second, the workplaces that hire graduates encourage continued education. Approximately half of LCC's graduates end up going to academic laboratories, where "climbing the academic ladder" (JD & JG, p. 18) is a part of the culture, including considerable tuition assistance for continued education. For example, laboratories at CWRU offer a tuition wavier of 6-credit hours per semester, along with the convenience of transitioning between labs and classes upon the same campus. The Cleveland Clinic offers $5,000 in tuition reimbursement annually toward a bachelor's degree, and numerous companies have similar policies for working toward science-related bachelor's degrees. A few students go on through medical school.

AAS degree program graduates are also driven to pursue further education in order to stay competitive in a job market that values education. This is especially the case for students who choose to pursue careers in academic or university medical center laboratories. One graduate of the AAS degree program in Biotechnology Sciences at LCC who completed his unpaid internship at the Cleveland Clinic experienced challenges being on the job market immediately following his associate degree completion. He shared that:

> I got passed on quite a few jobs with just having my associate's. … It wasn't that I couldn't find a job. It was just all the jobs I was applying for, there were a lot of people applying. So they were taking the people with a higher education. So it wasn't that I was unqualified for the jobs skills wise; it was just the educational level, they had, you know, more edge. … Once that happened a couple of times, I decided that I was going to go on with my 4-year [degree], just to give me that edge in the job market. (Graduate Interview, Oct 2012, p. 2)

This AAS degree program graduate felt particularly frustrated about being passed over for a full-time position in the laboratory in which he completed his internship. The laboratory had spent one month providing him with extensive training on the operation of flow cytometry machinery – a role that "interested [him] and that's why [he] wanted to do it." However, when it came to a full-time position in the laboratory, he was viewed as unqualified due to his educational level. The AAS degree program graduate reported that:

> They'd already trained me on every single machine, so I already knew everything I needed. Yet their administrator basically forced them to hire a person with a bachelor's degree, even though they had zero experience on the machines. So you know, they hired them. (Graduate Interview, Oct 2012, p. 5)

The AAS degree program graduate, within his frustration, also pointed out potential weakness of the hiring practice of overlooking associate degree graduates, sharing that:

> The last I knew, [the bachelor's degree holder that they hired] worked there 6 months and then they quit and moved to a different job. So the administration stepped in and really hurt them. Because I could've worked there for, almost two and a half years, been there working while I was going to school. And I'd have been completely fine with it. (Graduate Interview, Oct 2012, p. 5).

This sense that bachelor's degree holders are not going to stay in entry-level jobs, requiring constant retraining was echoed by some employers as well. [See writing from interviews at the Cleveland Clinic.]

Program administrators at LCC suggested that the most prevalent barrier to their AAS degree graduates furthering their education is time. Graduates of the AAS degree program are often working full-time in a research lab or balancing responsibilities of family and children along with their professional pursuits. One program administrator reports that "many [AAS degree graduates] think about quitting their full-time job to return to school, but it is a difficult choice" to make (JD, July 2012, p. 1). It simply depends on "where they are in their lives" (JD & JG, p. 20).

Employment Rates. The program director of the Biotechnology Sciences takes steps to track all students – "what degree they had when they came in, where they went to college, what degree they got or where they're at, and where they're placed at a lab, whether it was an industry lab or an academic lab" (JD & JG, p. 20). This information is kept by the program director who maintains an email list of program graduates. He reported that "I typically know where a former student has found employment or transferred to a bachelor's program for at least a year or two after graduation" (Bioscience Technology Program Review, 2008, p. 10). After this period of time, tracking graduates becomes more difficult. There are some graduates that he has lost connections with as they move beyond their first job in the field. There were some student-led efforts to set up an network on MySpace, but the project did not catch on.

Program administrators reported that their employment rates for AAS degree graduates are high – "100% since 2003" (JD, July 2012, p. 2). About 50% of the time, internship sites hire students directly out of their internships. This is "partly by design," as the program director described:

> I like to place students in research labs that are looking for a tech. So if this is an 8-week job interview, it's the longest interview of your life. But if things work out, then there's a job at the end. (JD & JG, p. 24)

The program director mentioned that placement was "a little more difficult" this year because "we're in a little bit of a lag economy wise" (JD & JG, p. 6). However, there was also a sense that the biotechnology field was "kind of sheltered because they're NIH-funded, so they're not really economy driven" (JD & JG, p . 6). The most common employers of their graduates are the research laboratories at the Cleveland Clinic, CWRU, or the biomedical and technology companies that are spin offs or have sprung up in niche areas that support "these research giants" (JD, July 2012, p. 2). The 2008 Bioscience Technology Program Review report points out that "approximately equal numbers of program grads find employment in industry versus academic research laboratories" and that "this demonstrates a well-rounded preparation for a wide range of opportunities" (p. 12). The ability of graduates to successfully seek employment in a variety of environments is viewed as evidence program quality.

Scientific publications. Within the 2008 Biosciences Technology Program Review, as evidence of student learning and achievement, program administrators report that, to date, program graduates had published 28 articles in scientific journals. On three of these articles, LCC graduates had served as first author.

Descriptions of evaluation efforts.

College and university-wide assessment efforts. LCC has a college-wide Learning Outcomes Assessment Committee (LOAC), established in 2001 in response to faculty discussions a challenge from the Higher Learning Commission of the North Central Association of Colleges and Schools to engage in learning outcomes assessment. The LOAC is a faculty driven committee, charged with the purpose of promoting "learning outcomes assessment for the purpose of fostering continuous improvement of the teaching/learning process" (LOAC, 2010-2011 Annual Report, p. 2). The goals of the LOAC include:

- To engage faculty in learning outcomes initiatives and use their input to advance and improve the process.
- To embed learning outcomes into the academic culture and curriculum.
- To measure the effectiveness of the college, department/program, and individual courses in meeting learning outcomes.
- To use assessment data for continuous improvement.

The committee website provides departments with a guide for developing mission statements, department and program learning outcomes, and assessment plans. A framework is also provided for evaluating the need for and appropriateness of new courses and programs, as well as determining the need for revisions or discontinuation of current programs. There is also a list of five institutional learning outcomes provided, including: learns actively, thinks critically, communicates clearly, uses information effectively, and interacts in diverse environments. For each of these outcomes, specific performance indicators are provided or all LCC learners (see: http://lakelandcc.edu/learningoutcomes/outcomes.asp, retrieved May 16, 2013).

Part of the LOAC's work has been "making student learning outcomes as visible as possible" (KR, Oct 2012, p. 8) across the campus. Promotional materials for these learning outcomes have been developed in the form of posters that are displayed in every classroom on a yearly basis, and faculty are encouraged to include these learning outcomes in course syllabi, as well as to connect these learning outcomes to course assignments and grades to ensure students' ability to master these tasks.

Program review. Approximately 5 or 6 years ago, LCC created the DAPR (pronounced "dapper") program, a Department and Program Review system which creates a set of criteria that each major and degree program must adhere to. The DAPR program is a faculty-driven assessment initiative, that is connected to the institution's HLC accreditation process. It is used to facilitate program review, which LCCs is "starting to go through [on a] traditional four year cycle" for each program (KR, Oct 2012, p. 2). As described by an institutional research associate, using the DAPR, an "assessment coordinator on the academic side of the house" partners with program faculty to "work through the data and ask specific questions about how they can continue to improve their program." Data included in the DAPR reports includes enrollment trends and GPA distributions in the program and individual courses over the past five years, including breakdowns by demographics (e.g., gender, ethnicity, age, enrollment status,), course teaching method (classroom-based, online, hybrid), and instructor. Degree graduate profiles are also included. The DAPR reports provide a consistent presentation of information across degree programs so that Deans and Provosts can compare different programs on similar measures.

Initially, when the requirement to demonstrate quality via a robust, outcomes-oriented program review was introduced, it was not viewed favorably. As described by the Biotechnology Sciences program director:

> Up until that time, if you had asked me, I was actually dragged kicking and screaming through this quality thing, because obviously I would say we've got a quality program. Look at my placement rate into jobs. We've got a great reputation. We've got people coming to me, like Ursuline College, for transfer degrees.

Yet, with time and support from assessment staff across the institution, the value of these new types of measures became apparent. They spoke of the process that faculty take to design learning outcomes and measures:

> What exactly do we want our students to know when they leave here? I want them to be good lab citizens. Well, what does that mean? Well, that means that you don't use the last little bit of enzyme and then not tell anybody, so the next person doesn't have it. Or, you don't leave your dirty glassware around. Then you got to go through, well, how am I going to measure that? ...
>
> [And], there's two sets of outcomes really. There's program outcomes and student learning outcomes. A program outcome might be that 98% of the students will pass the exam the first time around. The student learning outcome might be that they successfully find a job within 6 months.

Different degree programs have taken different levels of ownership over their DAPR data and the process of interpreting the findings. As described by an institutional research associate, the Biotechnology Sciences program director is known to take a hands-on approach to program review and data analysis –

> He keeps a lot of his own data. He is one of those people, like other programs in the sciences and the businesses, they are accustomed to numbers. They are accustomed to holding on to data. They are accustomed to doing a lot of that themselves, and having a lot of that at their fingertips. (KR, Oct 2012, p. 4)

One or two program outcomes are assessed per year – not every outcome can be assessed across and entire program every year. Decisions regarding which outcome to assess are made in consultation with campus-level assessment experts. The college's research department provides student trend data over a period of five years, so that decisions may be made base on what has been occurring over time. Program faculty and administrators must then develop an action plan based on their review of the data. Action plans are updated every year. Because this process is driven by a faculty committee and that committee "has learned all the processes (for assessment) and really go in and help individual faculty", the hope is that engaging in this process will help demonstrate to external audiences that "we're doing something about quality" (JD & JG, p. 17).

Sharing What Works: Replicability and Usefulness to Others

One of the challenges to seeking replication and standardization in the biotechnology field is the specialization that is seen in programs across the country, and how tied each program is to local economies and needs. As described by LCCs' Biotechnology Sciences degree program director, "if you look at the programs across the country, you come away with just chaos really" (JD & JG, p. 8). Programs that use the title of biotechnology range from biology programs that have added a few biotechnology laboratories to their regular courses, to programs that have added a biotechnology capstone project or internship, to a certificate program designed to train people to the needs of one specific company, to entire degree programs designed to teach biotechnology curricula such as Madison Area Technical College which was the first biotechnology program developed in the country. Even when looking at degree programs modeled after Madison Area Technical College (e.g., LCC, Sinclair Community College), "there's sort of an undercurrent of programs that have similar designs, but [they] do meet local needs" and therefore have notable differences (JD & JG, p. 8).

Ursuline College's Bachelor of Arts (BA) in Biotechnology

Ursuline College (UC) was originally founded in 1871 by the Ursuline Sisters of Cleveland to address the need for an institution of higher learning for women. At that time, Mother Mary of the Annunciation Beaumont, the first superior of the Cleveland Ursulines and the foundress of UC, obtained a charter from the state of Ohio to establish a college "to confer, on the recommendation of the faculty, such degrees and honors as are conferred by colleges and universities in the United States" (http://www.ursuline.edu/About/ursuline_heritage.html, Retrieved July 1, 2013). UC became "the first women's college in Ohio and one of the first in the United States" (http://www.ursuline.edu/About/index.html, Retrieved July 1, 2013). In the early days, enrollment was open to "the public of all races and creeds who qualified scholastically" (http://www.ursuline.edu/About/ursuline_heritage.html, Retrieved July 1, 2013).

In 1968, the college was reorganized as a non-profit with an independent Board of Trustees. The Ursuline Sisters of Cleveland continued to serve as the institution's founding religious congregation. UC began offering graduate programs in 1982, followed by an accelerated nursing degree program for working adults in 1997. UC also has an accelerated degree program for students who already have a bachelor's degree but are interested in earning a Bachelor of Science in Nursing (BSN) degree (http://www.ursuline.edu/About/ursuline_heritage.html, Retrieved July 1, 2013).

Currently, UC offers more than 30 bachelor's and 9 master's degree programs, offered in three schools: Arts and Sciences, The Breen School of Nursing, and Graduate and Professional Studies. Students also have the opportunity to finish an undergraduate business degree or legal assistant's degree in an accelerated format (http://www.ursuline.edu/About/index.html, Retrieved July 1, 2013). The institution is described as a "Catholic liberal arts college, focusing on women, [that] welcomes students into an academically challenging and values-based environment" (Undergraduate Fast Facts, 2011-2012, p. 1). The campus, located 15-miles east of the downtown Cleveland area in Pepper Pike, Ohio, is described as "safe, intimate, and easily accessible" (p. 1).

The mission of UC is to offer holistic education that transforms students for service, leadership, and professional excellence by providing undergraduate and graduate programs that foster lifelong learning and personal wisdom in an environment characterized by:

- Catholic and Ursuline heritage
- Women-centered learning
- Values-based curricula
- Inclusive, global perspective

The institution also has a set of its core values that guide institutional philosophy. These include:

- Student Focus
- Demonstrate that students are our priority
- Support student learning
- Measure our success by the success of each student
- Empower students to take responsibility for their own education and future

Spirituality

- Balance action with contemplation
- Develop awareness of spirituality, faith and religion
- Increase awareness and clarity about personal and professional values
- Leave the world a better place

Respect

- Demonstrate dignity and respect for everyone
- Value, trust and help each other
- Strive for justice and fairness in all relationships
- Recognize and acknowledge achievement on every level

Collaboration

- Involve others to multiply effectiveness
- Achieve goals through productive cooperation in the College and world community
- Appreciate synergy that comes with involvement from multiple perspectives
- Model collaboration in all of our activities and endeavors

(http://www.ursuline.edu/About/mission_vision_philosophy.html , Retrieved July 1, 2013)

UC's Current Students

According to the NCES' IPEDS College Navigator, in Fall 2011, a total of 953 students were enrolled in undergraduate degree programs at UC (159 – or 17% – of those as transfer-in undergraduate students). Of those students, 61% attend full-time and 39% attend part-time. Approximately 91% of undergraduate students are female, and 9% are male. A total of 65% of the undergraduate student body self-identified as White /Caucasian, 28% as Black or African American, 2% as Hispanic/Latino, 2% as two or more races, 1% as Non-resident alien, and 1% as Asian. A total of 92% of students are in-state residents, with 8% being out-of-state students. In regards to students' age, 51% were reported as 24 and under, and 49% were reported as 25 and older.

Of first-time, full-time students who began their studies in Fall 2005, 54% graduated within 150% of the typical completion time for their degree program. No transfer-out rate was reported. The 6-year graduation rate was slightly higher for males (63%) than for females (54%). Six-year graduation rates by race/ethnicity were reported as follows: Asian: 0%, Black/African American: 32%, Hispanic/Latino: 100%; White: 60%; and Race/ethnicity unknown: 33%.

The IPEDS data from Fall 2011 reports the student-to-faculty ratio of UC is 8:1. The institution had 69 employed full-time faculty and 145 part-time faculty, all primarily serving in instructional roles. Of the full-time faculty, "61% hold the highest instructional degree in their fields" (Undergraduate Fast Facts, 2011-2012, p. 1).

UC reports that it is "in the lower middle third of tuition rates for private colleges in the state of Ohio" (Undergraduate Fast Facts, 2011-2012, p. 1). Students are charged tuition by credit hour. For a full-time student taking 30 credit hours a year, tuition is $25,530 (http://www.ursuline.edu/About/index.html, Retrieved July 1, 2013). Scholarship opportunities are available for students who have a 2.8 GPA or higher. Overall, 86% of students receive some type of financial aid, and 99% of incoming freshmen receive financial assistance (Undergraduate Fast Facts, 2011-2012, p. 1).

BA Degrees in Biology and Biotechnology.

Curriculum design. The Biology Department at UC divides its course of study into two curricular components: the fundamentals and the specialization (http://www.ursuline.edu/Academics/Arts_Sciences/Biology/index.html, retrieved July 15, 2013). The fundamentals provide an understanding of "basic terminology, concepts, and perspectives" that are necessary to advance in a specialization area. Examples of courses that provide instruction in the fundamentals include: (a) Introductory Biology – Biodiversity, Form, Function, and Ecology (BI 200), and (b) Introductory Biology – Cells, Genetics, Energy Transfer, and Evolution (BI 205).

Academic Tracks. The Biology Department at UC offers Bachelor of Arts (BA) degree program offerings in three academic tracks: Biology, Biology – Life Sciences, and Biotechnology. Each track offers a different occupational focus.

The Biology track, also known as the "professional course of study," is designed to prepare students for further study in biological sciences or a variety of professional or graduate schools after completing the BA degree (http://www.ursuline.edu/docs/academics_biology/biology%20track.pdf, retrieved July 15, 2013). Students generally enter graduate school either directly after completing the BA, or after one to two years of work experience in the field. Future education opportunities are marked by a great deal of variety. Fields of study could include molecular biology, immunology, biochemistry, pathology, plant physiology, ecology, etc. Degrees pursued could include an M.S., M.A., Ph.D., D.S., M.D., D.O., D.P.M., D.D.S., D.M.D., or D.V.M. Within the required core coursework for the BA in Biology degree, students are required to complete 47 credit hours of math and science coursework. Included in this coursework is a series of Chemistry courses (Principles of Chemistry I and II with lab, Organic Chemistry I and II with lab, Biochemistry with lab), General Physics I and II with lab, six credits at or above College Algebra, a series of Biology courses beyond the foundation (Ecology with lab, Cell Biology with Lab, Genetics with Lab), a Biology capstone seminar, a research project, a program evaluation, and a service learning in Biology experience.

The Biology – Life Science track, also known as the "biology course of study," offers students "more autonomy in selecting their undergraduate course of study" (http://www.ursuline.edu/docs/academics_biology/life%20science%20track.pdf, retrieved July 15, 2013), as compared to the Biology track. In this track, students may select courses to receive a broad survey of biological sciences courses or may seek a narrowly focused approach highlighting a particular area (e.g., health sciences). This track also provides flexibility for students who wish to pursue a double major. Students who pursue the Life Science track are also more likely to enter the workforce directly after graduation, although seeking graduate or professional school can be an option "if course choices are made judiciously" throughout their degree program. One program option available to students in the Life Sciences track is to seek a Medical Technology program affiliated with The Cleveland Clinic School of Medical Technology. Medical technologists use modern laboratory technologies to assist with improving patient health. In this program, UC juniors in the Life Science track who have completed at least 96 credit hours may apply for admission to The Cleveland Clinic School of Medical Technology, and may complete the two programs (BA and Medical Technology) concurrently. Students need to plan ahead in order to take advantage of this program, as specific courses in biology, chemistry, math, and physics are required as science prerequisites for acceptance into the program. Within the required core coursework for the BA in Biology – Life Sciences degree, students are required to complete between 44 to 46 credit hours of math and science coursework. Included in this coursework is a series of Chemistry courses (Principles of Chemistry I and II with lab), College Algebra (or above), 8 biology elective credits at or above the 300 level, a Biology capstone seminar, a program evaluation including the Major Field Test, and a service learning in Biology experience. Three additional hours of approved microcomputer/mathematics are also required. Additional coursework is recommended for those anticipating attending graduate or medical technology school, including: Organic Chemistry I and II with lab, Biochemistry with lab, General Physics I and II with lab, and Math 121 and 122.

The Biotechnology track is offered as a joint program between UC and LCC. It is based on a 3:1 model, with three years spent at UC obtaining the requirements for a BA in Biology, and one year spent at LCC taking technical courses for their certificate in Bioscience Technology. The aim is to "combine hands-on technical experiences gained at Lakeland with the philosophical and traditional liberal arts science education offered by UC" (http://www.ursuline.edu/docs/academics_biology/biotechnology.pdf, retrieved July 15, 2013). Students in this program generally enter the workforce at the conclusion of their degree program, working in disciplines such as agriculture, environmental science, pharmacology, genetics, and medicine. Within the required core coursework for the BA in Biotechnology degree, students are required to complete between 81 to 82 credit hours of math and science coursework – almost twice as many

technical credits as the other two Biology tracks. Included in this coursework is a series of Chemistry courses (Principles of Chemistry I and II with lab), Statistics, a series of Biology courses beyond the foundation (Environmental Microbology with lab, a Departmental Seminar, and an Independent Study), as well as 4 Biology electives (with only one at the 200-level) and 2 general electives chosen with the approval of the biotechnology faculty advisor. The remaining 31 credit hours of technical credits are taken as a part of the certificate program at LCC.

Beyond these three major professional courses of study, the Biology Department does offer a 23 credit hour Biology minor. For Education students, the Department also offers a major in Life Science education and a concentration in science for middle childhood students.

Math requirements. The math requirements for Biology students at UC vary, depending on a students' chosen academic track, as well as his/her educational and career goals. Students within the Biology track are required to complete six credit hours of math courses at or above College Algebra, while students in the Biology – Life Sciences track are required to complete a minimum of College Algebra and students in the Biotechnology track are required to complete Statistics. Further, students who intend to pursue the Medical Technologist program at The Cleveland Clinic are cautioned to be aware that higher math and physics pre-requisites may be required to pursue their educational and career aspirations.

Departmental honors program. A departmental honors program is available to Biology majors who have a strong academic background, as demonstrated by maintaining a cumulative GPA in their biology courses of at least a 3.00 and completion of key courses such as statistics and chemistry. Students must apply to the honors program and be accepted by the Department Chair. To earn Departmental Honors, a student must successfully complete an Experimental Project (BI 452) or Senior Thesis (BI 453).

Enrollment and Student Demographics

UC faculty spoke of their student population as non-traditional in several ways. On the one hand, there are the students who come directly from community colleges, such as LCC. These students were described as coming from "a working class kind of environment. My parents didn't go to college, and so, I didn't know anything about what college was" (Faculty focus group, Oct 2012, p. 6). For these students, even the idea of coming to UC may be a frightening prospect, and helping to build a student's self-efficacy for engaging the bachelor's degree study environment is often an important first step.

On the other hand, UC was described by faculty as having "a long tradition of picking up people in their middle of their education, or the end, and bringing them in here and letting them finish" (Faculty focus group, Oct 2012, p. 6). These students may have come from another four-year institution, may have swirled between many institutions, or may have stopped out from higher education for a period of time. UC is known for working with these students to provide transfer credit and lifelong learning credit in order to ease transitions and to provide students with a "chance to have a legitimate liberal arts [degree] at the end" of their studies (Faculty focus group, Oct 2012, p. 6). Providing a "rough estimate," the Biology faculty stated that, with the influx of transfer students, the campus generally doubled their student population, and that the ratio of transfer students to native students may currently be a bit higher in the sciences as compared to other majors.

There is a "general sense" among UC faculty and administrators in the Biology Department that they are "not many students' first choice" institution – they are a "second-choice school" (Faculty focus group, Oct 2012, pp. 14-15). Many of their students have had the experience of going off to "a grandiose first-year college" and something happened – "that whole freshman experience was a disaster" (Faculty focus group, Oct 2012, p. 15). Along the way, these students have had their confidence shattered – "they are demoralized; they don't feel like they can do anything" (Faculty focus group, Oct 2012, p. 15). UC Biology faculty, however, say that they notice a difference in students' demeanor when they receive individualized attention and support. As one faculty member described:

> When we give them that attention, it really kind of boosts them into saying, "Hey, I really can do this. Maybe I had a bad first year, but I can work past that and keep on going."
>
> I think that's what's really great, is that everyone here at the college supports the students. You might be a Biology student, but you can go to the English department and get support from another faculty member. That's what really kind of helps those transfer students that didn't have a great first-year experience. (Faculty focus group, Oct 2012, p. 15)

The faculty members reported that their graduation retention of transfer students is higher than that of first-time incoming freshmen students.

Faculty Roles and Descriptions

At the time of our site visit, the Biology Department was made up of six full-time faculty members and one lab assistant technician, whom the faculty members lightheartedly acknowledged as "[running] the department" (Faculty focus group, Oct 2012, p. 1). Collaboration – among faculty members, faculty and students, and across academic departments – is a core value expressed by this faculty group. In fact, they highlighted this value during our site visit, noting that the focus group meeting was arranged with the entire Biology department in attendance as an example of the collaborative nature of their work environment.

Articulation and Transfer

Faculty in the Biology Department reported that they "always had some kind of relationship with community colleges in allowing a two plus two blanket credit transfer" for liberal arts associate degree programs to their BA degree programs (Faculty focus group, Oct 2012, p. 2). The transfer of associate of applied arts (AAS) degree programs, however, are "a different story" (Faculty focus group, Oct 2012, p. 2). When the Biology Department faculty began looking at AAS degree programs, they recognized the specialized nature of the training that is provided – "there's quite a bit of information that's relatively technical" (Faculty focus group, Oct 2012, p. 2). On the one hand, this program design differs considerably from the typical two years of a liberal arts undergraduate program. On the other hand, "the nursing school [that was a part of UC] also has that technical side to it" (Faculty focus group, Oct 2012, p. 2). Seeing things in this light encouraged the Biology Department faculty to start looking at two-year, technical AAS degree programs in a new light. Could they "think of it more like a junior year abroad type thing" (Faculty focus group, Oct 2012, p. 2)? Faculty continued this metaphor, saying "often times people go to a 4-year college and they spend that junior year in Europe studying whatever… [and so we] tried to encourage people to accept it, to think of it as the junior year abroad" (Faculty focus group, Oct 2012, p. 8). Students would spend their first two years at UC building foundational knowledge and skills in biology – material that would be complimentary to what LCC would offer. Then, they would take their technical classes at LCC during their junior year, learning techniques and gaining from a different perspective – "the whole culture of the industry is different over there in classes" (Faculty focus group, Oct 2012, p. 10). Then students would return to UC for their senior year to complete courses such as the research seminar. Or, students could choose to do their senior year internship through either UC or LCC "depending on where they decide to do their work" (Faculty focus group, Oct 2012, p. 9). In this way, the

degree program is a 2:1:1, yet the final year is "sort of like a slushy one" (Faculty focus group, Oct 2012, p. 8) because students have flexibility to take advantage of internship opportunities that best suit their interests and needs.

Another metaphor used for this type of degree program partnership was the idea of an "inverted bachelor's degree." One faculty member described this as follows:

> I really think that inverted bachelor's degree is something interesting to think about in community colleges, in that those classes are pretty technical, and they are very much equivalent to junior level type things. (Faculty focus group, Oct 2012, p. 8)

Whereas students with an AAS degree could not be given "blanket credit" for their degree programs, faculty began to consider where courses taken for the AAS degree could fit with the upper-level curriculum – "what we could consider our 300-level classes into our baccalaureate program" (Faculty focus group, Oct 2012, p. 2). These transfer students would then be left with between two and three years of coursework to finish at UC, depending on credits and courses they were bringing with them.

Another faculty member went on to talk about these articulations as a "hybrid" design, rather than "two entities that interact." He shared his thoughts on partnering the liberal arts biology degree with AAS technical degrees, as follows:

> It enables us to do what we do best, which is sort of a traditional approach to education, where vocational training is part of the story, but increasing the breadth of the individual for experiencing life after.
>
> Outside the workplace is also a big part of it. Basically, we spend a lot of time being a person versus just a technician. If somehow you could see more marketing that really strongly pushed the idea that the two programs together were the whole. It wasn't so much like two plus two; it was more like one. You know?
>
> It's a transitional issue. This isn't about you finish this, and now you're certified, and then you do this if you want to, to be something else or to have a different approach. So it would be neat if your articulations really create more of a hybrid itself as opposed to two entities that interact. But more like, well, this is a hybrid thing that you go through, and you can get technical training as well. Start out easy, with a college that maybe you're a little more comfortable with the community environment, getting your chops straightened out and worked up so you can get into a little more intense kind of collegiate experience. (Faculty focus group, Oct 2012, p. 16)

In this example the desire to blend, or creating a more seamless, integrated educational experience for students, is elevated.

With these initial ideas sparked, there was still much work to be done to set up articulation agreements with community colleges. Without "a lot of business formats" (Faculty focus group, Oct 2012, p. 2) to draw from and "various hurdles in the way" (Faculty focus group, Oct 2012, p. 5), some agreements did not get completed (e.g., Cuyahoga Community College's Biotechnology Program) and others "others ultimately went by and by" (e.g., Loraine Community College, Faculty focus group, Oct 2012, p. 2). However, strong interpersonal relationships with faculty at LCC and "concrete" connections with a specific program of interest (AAS in Biotechnology Sciences) facilitated the development of an articulation agreement that has lasted over time.

UC and LCC

Developing the articulation agreement between UC and LCC, while "there was a lot of work on the curriculum, looking at the courses and deciding what would work well" (Faculty focus group, Oct 2012, p. 3), was supported by a number of facilitating factors. First, a number of similarities were found between the two degree programs. For example, Biology Department faculty described similarities in capstone experiences for both degree programs as follows: "Our senior year was similar, we had a seminar and a research project, etc., very similar to [LCC's] program where a portion of the program, they'd go out and work in industry and do a presentation" (Faculty focus group, Oct 2012, p. 8). Both programs also require students to gain work experience through an internship near the end of their academic coursework.

The articulation was also facilitated by strong personal networks between the program faculty. For example, one UC faculty member who was teaching ecology courses in the Biology Department also had experience teaching as an adjunct faculty member for LCC, and in addition, had a close family member serving in administration at LCC. These close personal ties helped contribute to a sense of ownership and pride, driving the articulation agreement to success. As described by one UC faculty member:

> That seems to be a part of the articulations agreements that we have coming into Ursuline … [it] is really because of the personal relationships, knowing someone, and someone is invested in the program. Those seem to work best for us. They sustain themselves.
> (Faculty focus group, Oct 2012, p. 3)

As the articulation agreements between LCC and UC were solidified in the mid-2000's, degree pathways were created offering starting points at both institutions. In addition to a 3+1 pathway allowing UC students to "study abroad" at LCC to gain specialized biotechnology skills, a 2+2 pathway was created allowing LCC AAS degree graduates to continue on to UC to earn a BA degree.

Faculty at both institutions speak highly of the partnership. For example, one Biology faculty member at UC reflected that "great collaborations" exist between UC and LCC (LY, July 2012, p. 1). Lakeland Community College students are often encouraged to seek information on continuing their education at UC. Likewise, UC faculty encourage students with an interest in biotechnology to "go visit Lakeland" and to "get a full view" of the opportunities, especially the scholarship opportunities that are available to students who are taking courses at Lakeland Community College (Faculty focus group, Oct 2012, p. 17). The expectations are made clear for those students who would like to pursue a Biotechnology track and take advantage of the Lakeland Community College partnership.

Low Student Participation. Despite collaborations at the faculty and administration levels, student transfer rates between the two institutions remains small. Since the articulation agreements were developed approximately 7 years ago, Biology faculty members at UC estimated that two students have used the 3+1 pathway from UC to LCC and two students have use the 2+2 pathway from LCC to UC. Of the two students who transferred to UC, one graduated in the Biotechnology track while the other chose to pursue a different track in Biology. Faculty at both institutions offered insights into what might contribute to these low participation rates.

For students who start out at UC, the Biotechnology track is "an attractive program" and many "come with the intent to major in biotechnology" (Faculty focus group, Oct 2012, p. 4). However, as time passes, these students "really enjoy the experience" at UC and decide not to make the transition to LCC, instead opting to finish out their time in one of the Biology tracks at UC – "actually a majority of our students do that" (Faculty focus group, Oct 2012, p. 4). Faculty in UC's Biology Department reflected on several

factors that they perceived to influence this transition from biotechnology to biology. First, they saw that students often began at UC with the intent to major in biotechnology because they had developed a familiarity with the field. Often times, students had been "recruited out of high schools" to participate in programs that provided college credits for high school classes that exposed students to "biotech work in the high schools" (Faculty focus group, Oct 2012, p. 4). This early exposure to the career field helped students gain an understanding of the biotechnology industry and job opportunities available. This leads to a second factor motivating students to pursue a biotechnology major. Students come to UC already familiar with the connection between biotechnology and jobs, particularly in the local economy in the Greater Cleveland area. As described by an UC faculty member:

> It's the idea of biotechnology that attracts them [to UC]… biology majors, and parents particularly… they are looking for jobs. It used to be medical technology; people would go into biology because they wanted a job. If you're a first generation college student, you see that as a job out there. [Now,] I think initially it's biotech. Initially they see the companies in the area… So they have an opportunity to work in industry or other areas of research. (Faculty focus group, Oct 2012, p. 4).

While students come looking to gain the education needed for these jobs, they become exposed to a wider variety of opportunities as they progress through the UC curriculum. As expressed by one UC faculty member: "When [students] come here, they have that idea 'We're just going to get our degree and go work.' However, they realize that when they get here, they see all these other things that they can do" (Faculty focus group, Oct 2012, p. 4) as they engage both the science courses and the core curriculum, which "gives them a broader point of view" (Faculty focus group, Oct 2012, p. 5). There is also the impression that students are impacted by "the attention that they get" as they begin to "recognize [their own] capability too" (Faculty focus group, Oct 2012, p. 4) to accomplish academic tasks that they may not have considered in the past because they were so narrowly focused on obtaining skills for a job.

In general, students seem to move from the Biotechnology track at UC to the more general Biology track over all. Faculty suggest that students come to Ursuline with an interest in Biotechnology, but then realize that there is a greater variety of opportunities available to them with Biology. Students want to "expand beyond [the biotechnology] track" (LY, July 2012, p. 1).

Strengths of LCC's transfer students compared to UC native students. Biology faculty at UC perceive that students from LCC bring a number of strengths to a bachelor's degree program in the biological sciences. They describe "the main benefit of going to Lakeland first" as being "very technical [and] precise in their procedures" in the lab. They go on to say that "you give [LCC transfer students] a protocol and they know how to do it. They just go right in… They're totally independent" (Faculty focus group, Oct 2012, p. 11). This is in contrast to students who are starting at UC without training from a community college. Native students were described as being "very needy at the beginning… hesitant because they haven't had exposure to those stills yet."

Additionally, Biology faculty perceive that transfer students from LCC are "driven." They reflect that "it's kind of almost a different mindset" that transfer students bring in to the program. These students "are not necessarily here for an education, but it's a training thing" (Faculty focus group, Oct 2012, p. 11). Transfer students take the skill building seriously because they envision the direction connections to future jobs. For example, faculty members commented:

> Faculty Respondent 1: They definitely have good learning, good lab skills, good note-taking skills.
>
> Faculty Respondent 2: Their notebooks are just immaculate.
>
> Faculty Respondent 1: Their notebooks are beautiful… We do some of that [training with students], but not as rigorous and careful.

(Faculty focus group, Oct 2012, pp. 10,12).

Native students who are science majors are perceived by faculty members to "probably take those skills less seriously… they don't realize that they're being trained because they don't see that job" (Faculty focus group, Oct 2012, p. 11). One faculty member suggested that this might be an area where the faculty could improve communications with students to "be more careful about making sure students are trained" (Faculty focus group, Oct 2012, p. 11) and that students understand the connection between this training and life beyond the bachelor's degree.

Weaknesses of LCC transfer students compared to UC native students. Biology faculty at UC described the focus of their instruction as different than the focus of instruction at LCC. As students make the transition from one program to the next, they need to adjust, recognizing that "classes are a little bit different," as are expectations for learning and application (Faculty focus group, Oct 2012, p. 10). At LCC, emphasis is placed on learning techniques. At UC, emphasis is on "gathering data, collecting, analyzing the data, and then modifying your experiments again" (Faculty focus group, Oct 2012, p. 10). Faculty will "introduce the idea – the general concept of the laboratory structure," but then students have to "apply" the information and to "devise something on their own" to solve whatever problem or challenge is put in front of them (Faculty focus group, Oct 2012, p. 10).

As a result of this style of training, Biology faculty at UC perceive that their native students "have really great analysis skills, thinking beyond the box" (Faculty focus group, Oct 2012, p. 12). One faculty member gave the example of:

> You give them a protocol, and they might ask you several questions about it. When they're asking their questions, a lot of times I feel like they're asking why. "Why? Why do I need to do it that way?" You know? And so, when you ask them to take it to another level, they already kind of understand why they have to do certain things. "Now I can think beyond that, and how can I utilize it in other ways?" (Faculty focus group, Oct 2012, p. 12)

As they gain laboratory experience, native UC students gain strong troubleshooting skills. However, troubleshooting is a skill area that many community college transfer students still need to develop.

Summarizing the main themes of the weaknesses that LCC students bring to UC, one faculty member reflected that:

> The major gap is that they are very linear. They're very fact-based. They're very technical… [Lakeland students are] great an answering those multiple choice questions, where it's just straight facts. But [they struggle] when we give them those essay kind of questions where, "Okay, you have this situation. How do you apply your understanding?" … [or] to tell them, "Okay, these are the facts. I'm going to give you a problem. How do you utilize those facts to address the problem?" (Faculty focus group, Oct 2012, p. 13)

LCC students stumble when they meet challenges that require them to move beyond straight-forward application of facts, and when they need to apply information and skills in new environments or to new problems. This is where the integration of a biotechnology program into a liberal arts curriculum is viewed as a great benefit to students. As one UC faculty member shared, the degree program at UC "promotes critical thinking, communication, and writing across disciplines. Transferring skills starts to pay off. In my opinion, that's the difference. They're learning to analyze material in their [general education] requirements" (Faculty focus group, Oct 2012, p. 13) as a part of the Bachelor's of Arts experience.

Other articulation agreements. UC also has a partnership with the Ohio College of Podiatric Medicine (OCPM) to offer its junior students an accelerated pathway to achieving the degree of Doctor of Podiatric

Medicine (http://www.ursuline.edu/Academics/Arts_Sciences/Biology/index.html, Retrieved July 15, 2013). Students who are studying Biology at UC may apply for admission to the OCPM during their Junior year, once they have completed 90 semester hours, including specific prerequisites in Biology, Chemistry, Math and Physics. Those who are accepted and transfer early to the OCPM, are awarded their BA degree from UC after successful completion of one year of study at OCPM.

Barriers and Challenges

External pressures from state policy influences. Biology faculty from UC discussed some of the challenges that their institution faces partnering with other higher education institutions across the state. UC operates as a small, private, liberal arts college within a public environment that is influenced heavily by state policy which is written from the point of view of larger, public universities, four-year colleges, and community colleges. These policies push for agreements and relationships that UC does not always agree with and, when disagreements arise, they feel that some of their public institution peers place them in a category of "the second tier" partnership schools (Faculty focus group, Oct 2012, p. 4). As a result, UC is at a disadvantage for attracting students, particularly for transfer, which is a primary source of student enrollments. There is a hope that "with time that will change" (Faculty focus group, Oct 2012, p. 4), however, UC must continually be proactive to advocate for change of this message and positioning.

One example of the public policies that "prevents [UC] from increasing marketing in the State [of Ohio]" is that public institutions have been mandated to partner through the use of Transfer Assistance Guides (TAGs) which require seamless transfer of 64 credits from the two- to four-year public institutions within the major, rather than just electives. Faculty at UC described this as "a huge roadblock right now for private 4-year institutions… We don't agree with all the TAGs [because] you're saying every school is the same – every class is the same" (Faculty focus group, Oct 2012, pp. 17-18).

UC Biology faculty also reflected that two-year public colleges in Ohio have been gaining "definitely more say and more power" in recent years (Faculty focus group, Oct 2012, p. 18). As an example, one faculty member shared that:

> We've been approach for STEM areas from a 2-year college in Cincinnati, and they want 80 credits transferred in, to which we said: "we have to do half a major." They want them transferred in the major. We're stumped there, but yet they have agreements with other institutions in Ohio – 80 credits… They want their capstone course to come as our capstone. So they're taking a capstone at what we would say is a sophomore, and they want it to count for our BI 451, senior. (Faculty focus group, Oct 2012, p. 18)

UC faculty expressed concern that encounters such as these signified a tendency to reduce degrees to a sum of credit hours, rather than looking at the content of what each institution adds to the student experience. The four-year liberal arts degree was losing its meaning – what it meant to be "an educated parent, an educated voter, and educated reader, a citizen. That doesn't mean anything; it's what salary you bring in. What gets you a job" (Faculty focus group, Oct 2012, p. 18). For an institution committed to liberal arts education and values, this is a concerning prospect. As one Biology faculty member reflected, "if you're going to run it like a business, then understand you're going to lose quite a bit of quality" (Faculty focus group, Oct 2012, p. 19).

Future Directions

When considering future directions for the Biology Department at UC, the Biology faculty immediately reflected that "we would love to see more students" (Faculty focus group, Oct 2012, p. 15). While the faculty recognize the challenges they face, such as those related to being a small private institution working within the policy environment of public institutions, they aim to work to "see those kind of barriers broken down" (Faculty focus group, Oct 2012, p. 15). These faculty members express that they are deeply committed to this work because they believe that they can "give a lot to the students that are in [LCC's] biotech program" and other programs like it. Not all students thrive at large institutions, and "having a small institution might be ideal for some of them" (Faculty focus group, Oct 2012, p. 15). Suggested ways to set a foundation for expanding student enrollments included: (a) seeking NSF grants to support the development of articulation agreements, and (b) seeking articulation agreements with a wider variety of community colleges and degree program types (e.g., math).

Sharing What Works: Educational Significance

Individual and Societal Needs Addressed by the Program. When asked what makes the BA in Biology degree programs at UC distinctive, as compared to other undergraduate Biology degree programs, faculty members began by focusing on the idea of "connectivity" (Faculty focus group, Oct 2012, p. 20) – students get to know their professors, professors know each other, professors teach both lectures and labs. As a result, "students don't get lost in the shuffle" (Faculty focus group, Oct 2012, p. 20). Within this community environment, faculty members take responsibility for mentoring across the curriculum and students "take responsibility for their learning" (Faculty focus group, Oct 2012, pp. 21). The relationships and community that is built over time are evidenced during students' senior presentations. One faculty member shared that:

> I always like it when they do their senior presentations because it's nice to see the math department there; they're almost always there sometimes if it's related to, you know, we get people from other departments coming. So that's a good thing in science, too, is to see other departments interacting. (Faculty focus group, Oct 2012, pp. 21).

These connections also lead to another "attractive" feature that is more often recognized by senior students than freshman students. As described by one faculty member, because of the close relationships between students and faculty, "when it comes time to move on to another program, [and students] need a letter of recommendation, they could be able to pretty much ask any of us to write it for them" (Faculty focus group, Oct 2012, pp. 22).

A second highlight of the UC degree program was that it stresses "investigation" and "application," rather than "just simply feeding them facts after facts after facts" (Faculty focus group, Oct 2012, p. 20). For example, one faculty member described the lab activities that are developed for junior and senior students saying:

> They're not cookbooks… A lot of times when we create labs, we don't know what the results are going to be, because we're trying to give them the experience of what they're going to be like in the research setting, and have them really apply all that information. So I think those qualities really make us stand out. (Faculty focus group, Oct 2012, p. 20)

Further, this element of investigation and exploration is not limited to science courses. Faculty describe the purpose of "the college as a whole" as being "really to explore the individual… the whole person" (Faculty focus group, Oct 2012, pp. 20-21). Faculty provide advising to help students see that it is "not [about] just trying to get these classes out of your way," but that the College is trying "to give them a variety of courses that will help them become more well-rounded individuals" (Faculty focus group, Oct 2012, p. 20). One faculty member reflected that, for her, she can identify a great success at the end of the Biology senior seminar when a student says: "Everything I learned, I really don't know" (Faculty focus

group, Oct 2012, pp. 22). This is an important insight for students because "you graduate from science knowing that you don't know… In science, that's what it's all about. We're learning" (Faculty focus group, Oct 2012, pp. 22).

The Biology faculty at UC also seem themselves as more well-rounded than their counterparts at large research institutions. At a large research institution, faculty tend to specialize in niche research areas so that when students work with a faculty member, they too "basically get categorized into a real focused kind of idea about a particular research focus depending on who your advisor is" (Faculty focus group, Oct 2012, p. 21). Yet, in a small program like at UC, faculty must be generalists with "broad interests [and a] classical biology training" (Faculty focus group, Oct 2012, p. 21). One faculty member shared that: "We're eclectic, which I think is a big deal. It gives flexibility in the workforce" (Faculty focus group, Oct 2012, p. 21). And yet, if there is a research area or specialty that interests a student and is not covered in the UC faculty's eclectic expertise, the UC Biology faculty insist that students can take advantage of the resources available in the Cleveland area via partnerships with The Cleveland Clinic, Case Western Reserve University, or other "high-end labs." In this sense, their students have access to "the best of both worlds" (Faculty focus group, Oct 2012, p. 22). The ability to explore multiple avenues, and to develop a sense of flexibility, were viewed by the UC faculty as strengths for students who are exploring their options in a scientific field and workforce that is rapidly changing.

Also in comparison to Biology degree programs at larger institutions, faculty members at UC reflected that they had the policies and resources in place to give students a second-chance at a bachelor's degree in the sciences. As one faculty member stated:

> Our admissions requirements are to the college, not to the school, and you have our admission requirements, we are willing to take a student who may have stumbled in high school, who would have never gotten into Case [Western Reserve University]. We have the resources and we have the faculty who will work with that student. So I think that makes us a little more attractive. (Faculty focus group, Oct 2012, p. 22).

This accessibility and support provided to students is perceived by faculty to be an important distinguishing factor.

Instructional Pedagogy.

Hands-on experience. At LCC, all students in the AAS degree program are placed into internships that help them build connections to the workforce. At Ursuline, bachelor's degree students are required to complete a hypothesis-driven research project. As described by one faculty member, the internship program gives hands-on experience, while the research project brings students to "another level of understanding and application" of scientific knowledge (LY, July 2012, p. 2).

Skill development and critical thinking. The Biology seminar class was described as "extremely work-intensive" (Faculty focus group, Oct 2012, p. 13). Students are required to write a paper everyday, with each paper both summarizing information and providing some support for arguments presented. One faculty members shared that:

> In the first couple of weeks it's very difficult for students who have only spent one year with us when they're there. … It seems to be that our [native UC] students seem to pick it up a little bit faster, even if they are, you know, not our brightest bulbs in the class. They go, "I can't say that. She will yell at me if I don't have something that's supporting it." (Faculty focus group, Oct 2012, p. 13)

Through repetition and practice, students build up an awareness of good habits related to writing, forming quality arguments, persuasion, and critical thinking.

Lifelong learning credits. Students who return to school with considerable experience may develop and submit a portfolio to an academic department to be evaluated for the award of lifelong learning credits. These credits are awarded through a process referred to as an External Learning Assessment (ELA), which allows the award of academic credit "for learning gained outside of the classroom through on-the-job training, volunteer experiences, significant personal events, etc." (http://www.ursuline.edu/Student_Life/Academic_Information/index.cfm, retrieved July 17, 2013). ELA credits are awarded toward elective credits, and credits are awarded for "learning" rather than "experience." The distinction made is that "experience is a description of events; learning is the product of what you take away from the experience, and how you translate the experience into future situations." Additionally, the learning must be college-level (similar topic to what might be found in a college course), students must show a depth of knowledge, and the learning must be measureable and verifiable.

Supports provided to help students achieve positive results and outcomes.

Dedicated Faculty. The student-to-faculty ratio at UC is kept small at 9-to-1, which "puts faculty at the center of [students'] education" (Faculty focus group, Oct 2012, p. 7). Faculty shared that "We talk to every student… we know them by name" (Faculty focus group, Oct 2012, p. 7). In the Biology Department, class sizes are often kept to "maybe 10 or less" students per class so that students may receive individualized attention. Faculty members stressed that: "We've really tried to make a connection with every student… try to get to know every single student; try to really understand what their interests are" (Faculty focus group, Oct 2012, p. 6).

The small student-to-faculty ratios and close personal relationships lead to opportunities for advising and guidance. One example was given regarding helping students see new career options that fit with their personal passions:

> I actually just had a student about 2 weeks ago. She's in Nursing right now. She's a little bit older; I want to say she's maybe 24. She has hopped around to so many different schools. She was at Cleveland State [University], Tri C [Cuyahoga Community College], she might have been also at Lakeland [Community College] as well.
>
> She's currently now pursuing a Nursing degree because she wants a job. "I need a job. I've been at school forever, and I've been floundering around, and I need a job." However, she approached me because she says "I don't want to be a nurse. I wanted a job, but now that I'm here at Ursuline, I recognize that I want a degree in sciences. I want to become a scientist. What kind of career opportunities are there for me?"
>
> So we sat and we talked for a while. It happened very serendipitously, she was just finishing up lab, and my office is right outside of [the] lab, and so, we talked… She was so excited, and now she wants to transfer over to the biology department. She understands that she can actually have a career in biology.
>
> She explained to me, the reason she didn't think she could before is that, at all these other institutions, she was completely lost. She could never – at least in the pathway that she has previously approached the advisors, whatever advisors there were there – no one would give her a straight answer about a job career pathway in ecology. No one could.
>
> She said at UC she felt that she would not be lost. She would know her professors, and she could actually succeed here. (Faculty focus group, Oct 2012, p. 6).

Another Biology faculty member spoke more generally about how she reaches out to students who are struggling. She shared stories of working with "underrepresented groups" of students on campus who may not have a background to fully understand the expectations and culture of the higher education

environment. If these students do poorly on a first exam or project, they sometimes have an inclination to give up and leave the program. This faculty member responds in a very active manner, saying:

> [The faculty] are not going to let it go…. A couple of people just leave at that point, but we have people pestering them all the time. "Where are you? How come you're not here? Did you decide to quit? Do you want to give it another try?" (Faculty focus group, Oct 2012, p. 7).

In this way, the faculty members are working to reach out to students and to encourage their academic progress (valuing the individual), without lowering the academic standards that students must reach to achieve degree completion.

In interviews with our site visit team members, graduates of UCs' biology programs recognized the efforts that faculty members made to provide a highly supportive learning environment to help them meet the demands of the curriculum. One student shared that "the professors [at UC] were really great and encouraging" (Student2, p. 6). She appreciated their dedication, but recognized the limitations of what they could do for her, expressing that "[the faculty] always tried to work with you as much as they could. But I kind of feel like a lot of times there wasn't a lot they could do for you" (Student2, p. 6). For this student, the challenges of balancing school, work, and family life were extensive, making it difficult to complete the requirements for her degree. As she explained:

> For the internship, they wanted me to volunteer in a lab for, I believe it was, 8 weeks on a full-time basis. There was just no way I could do that. It would've meant that I had to quit my job or take some extended leave of absence from my job. It just was impossible. So I had to do a bit of improvising. ...
>
> The same problem came up for the senior project at Ursuline because I already had to have a place to go to do the project. And, it's not exactly PhD work, but it was extensive enough where you had to do so many weeks of actual bench work, and then, you have to put everything together and write about it and do a presentation. You basically have to turn in a paper and you have to turn in a presentation.
>
> I came to the first class, and I was already expected to have a place lined up, which, of course, I didn't. And I couldn't do it. I tried to kind of do it on the fly, but it didn't work out because there was the complication of being pregnant at the time too. They didn't really want to take you into the lab. I felt like one of the places where I applied, once they realized I was pregnant, they weren't so interested in taking my anymore. So I just decided that it had to be postponed, after the baby… when I could find a [inaudible] lab that would take me as an employee. (Student2, p. 4-5)

This student attributes her success in the degree program not only to the support of UC faculty, but also to her supportive family, and to her own sense of being "very stubborn." She said that she "just didn't want it to drag on for decades; I just needed it to be done" (Student2, p. 5). The combination of her own drive to complete the program, with faculty who encouraged her, listened, and asked for her opinions and insights (during and after her degree program experience) seemed to keep her moving forward toward her degree completion goals.

Career Development Assistance. Assistance with career decision-making, planning, and job searching was acknowledged in several ways across the interviews conducted during our site visits. During one interview with a graduate of the BA degree program, a participant mentioned working with a central career services office on campus. Her experience, however, was that the career services personnel "had no idea how to help me find what I needed" (Graduate 2, p. 8). She reflected that, despite her busy schedule of balancing school, family, and work, the career services personnel refused to work with her via distance technologies (e.g., phone, Skype). She was required to make an in-office appointment. When she did go in for an appointment, the career services personnel that she met with handed her:

> Two different job postings for medical device work, which I have no idea how he thought that would fit me because I was essentially a biologist. And the description clearly stated that it was for engineering or computer majors. And all he apparently saw was that it was a biotech company. (Graduate 2, p. 8).

This student found herself in the role of educating career services on the field of biotechnology. She found herself dismayed that "they had absolutely no contacts in biotech research area for some reason" (Graduate 2, p. 8).

As second place that students can turn to for career advice and assistance is the Biology Faculty at UC. Here we heard a mixture of stories, including powerful stories of helping students clarify their career paths (e.g., the example given in the previous section with the nursing student who transferred to Biology and found her path in the sciences), as well as students struggling to break into career opportunities even with the assistance of faculty members. For example, one program graduate mentioned that

> The most help I could get was my biology advisors and professors within the biology department, but Ursuline isn't a research facility like Case [Western Reserve University] or even CSU [Cleveland State University]. They just really are limited with their connections, because they don't do as much research there, so they're not as actively involved in the [research] community. So they just were able to advise and suggest, but they didn't really have too many contacts. (Graduate 2, p. 8)

This program graduate shared that she was very satisfied with the assistance she received with career exploration. Yet, when it came to implementing her career choice and networking to find her first position, she had hoped that her UC networks could have offered more assistance. This graduate reflected on her experience of searching for her first job, saying:

> It's very hard to get that first in. … I remember how impossible it was for me. It would never happen. Nobody even cared to barely speak to me. You know what I mean? Nobody was interested. I don't really know what questions to ask, or who to ask, where to go. I was kind of clueless and I felt really on my own a lot in that way. (Graduate 2, p. 11)

This program graduate now reflects that she "likes to be a resource" to new students and professionals in the field because "it should not be that difficult" (Graduate 2, p. 12). She wants to help people learn to network and make contacts in the field so that they may have a smoother and less-stressful transition to the world of work than she did. This perhaps signals a third source of career services support that may be available to Biology students at UC – program alumni – if there is infrastructure in place to help alumni and current students connect.

Financial assistance. Whereas the sticker price at UC may look high, many students do not pay that price that is advertised. Most scholarship opportunities at UC are available college-wide, as opposed to being targeted to a specific department or major. They are for students who have a 2.8 GPA or higher, and there are a mixture of need-based and merit-based scholarship options. Overall, 86% of students receive some type of financial aid, and 99% of incoming freshmen receive financial assistance (Undergraduate Fast Facts, 2011-2012, p. 1). Just under half of students enrolled received Pell grant funding (Faculty focus group, Oct 2012, p. 19). .

Sharing What Works: Evidence of Effectiveness and Success

Evidence offered as a demonstration of success.

Employment experiences. Graduate surveys across UC demonstrate that nearly 70% of respondents report working in their field of study at graduation, as compared to a national average of 45.3% (Undergraduate Fast Facts, 2011-2012, p. 1). It is estimated that UC has more than 10,000 graduates in total, with 8,000 residing in Ohio.

The Biology Department at UC graduates approximately 6 – 7 students per year. One student who transferred from Lakeland Community College with an AAS degree in biotechnology is now the manager of a cord bank company. She went on to complete a medical technician certificate as well. Another Lakeland transfer student is employed at The Cleveland Clinic, running a laboratory under the supervision of a research Principal Investigator.

NSSE data. UC, as a whole, outperforms other colleges in the areas of academic challenge, collaborative learning, student-faculty interaction, educational enrichment, and supportive campus environment, as demonstrated on their National Survey of Student Engagement reports. They share this result in their Undergraduate Fast Facts 2011-2012, as evidence of achieving the academically challenging, values-based, engaged environment that they seek to create and encourage student learning.

Sharing What Works: Replicability / Usefulness to Others

Advice to institutions considering AB degree pathways. In designing AB degree pathways, faculty members at UC provided advice to other institutions with two themes that are foreshadowed by the following introductory statement:

> If you're going to set up a strong matriculation, there has to be some feeling involved. It's not an agreement on paper between two institutions. There's people involved. And so, use your networking, and stick in your backyard. (Faculty focus group, Oct 2012, p. 22)

The two themes are: (a) seek to develop pathways in areas of strengths, and (b) build upon existing networks.

UC faculty members acknowledged that the road to building articulation agreements can be a long one. Administrative challenges are encountered when institutional cultures clash and hesitations are expressed, saying: "oh, by the way, we've never done this before." The slow pace of institutional inertia can leave people wanting to say "I'm not going to mess with this; it's a waste of time" (Faculty focus group, Oct 2012, p. 23). It is in these times that working in an area of specialty, on a project that teams are passionate about, can help articulations stay on course.

Second, UC Biology faculty spoke of the value of developing articulations with existing networks and colleagues, saying: "the articulations that work on campus are because of people – There are people involved that I can pick up the phone and call … I think friendships will break down the public and private barriers that exist." (Faculty focus group, Oct 2012, p. 23). These relationships are necessary both within one's own institution and across institutions that are entering into the agreements. They should include upper-level administrators, program administrators, and faculty members, to ensure that all stakeholders are informed and willing to engaging in negotiations and to make compromises.

OKLAHOMA STATE UNIVERSITY INSTITUTE OF TECHNOLOGY AND PARTNERS

This section presents case studies conducted in three organizations associated with the AB degree programs offered by the Oklahoma State University Institute of Technology and it's partners, Rose State College, and Tulsa Community College.

Oklahoma State University Institute of Technology's Bachelor's of Technology (BT) in Information Technologies, Associate of Science (AS) and Associate of Applied Science (AAS) in Information Technologies

The Oklahoma State University Institute of Technology (OSUIT) is a primarily associate degree-granting institution located in Okmulgee, Oklahoma, located approximately 40 miles south of Tulsa. OSUIT, when originally opened in 1946, was "a diploma-granting institution [and] did not offer any college degrees…it was essentially started as a vocational college for returning veterans" (BP, p. 1). Previously called Oklahoma State University – Okmulgee, it was opened by the Oklahoma State University (OSU) system after the system purchased the land and a decommissioned military hospital on the land for one dollar. The hospital had been around during World War II but was no longer needed after 1945. However, "[veterans] still needed help and rehabilitation" which served as one impetus behind the vocational focus of the institution – "the idea was, what can we teach these people that will help them get back into the workforce as quickly as possible?" (SN1, p. 4).

From 1946 to 1963, OSU-Okmulgee was under the leadership of a director, and it grew "from implementing a trade school to be a pretty good trade school. It had a decent reputation" (SN1, p. 4). The second President of the institution had a tenure that lasted from 1963 to 1983. In that time, the institution evolved from a trade school to an associate degree-granting institution, with the first Associate of Applied Science degrees implemented in the late 1970s. As reported by one program administrator, these degrees were originally called Associate of Applied Technology, yet "for whatever reason that fell out and [the degrees] became Associate of Applied Science" (SN1, p. 4).

OSUIT was accredited by the HLC in 1975. The third President of OSUIT served from 1983 to 2010. According to one program administrator, this President "took [OSUIT] from a fledgling technical college to a pretty good technical college." In approximately in 2002, the transferable Associate of Science degree was created at OSUIT, primarily to address the needs of geographically place-bound individuals who were seeking transfer opportunities to baccalaureate degree-granting institutions. The "big effort to roll out applied baccalaureate degrees" (SN1, p. 4) was undertaken in 2003, with the first Bachelor of Technology degrees approved in 2004.

The campus remains a member of the OSU system, and is governed by the OSU/A&M Board of Regents. OSUIT is "known for its hands-on technical education, its world-class equipment and its unique partnership with industry" (http://www.osuit.edu/about_us.html, retrieved August 6, 2013). Today, it offers more than 30 programs of study that lead to Associate of Applied Science degrees, four programs of study that lead to Associate in Science transfer degrees, and three programs of study that lead to Bachelor of Technology degrees.

Approximately two years prior to our site visit (around 2010) the Oklahoma Board of Regents placed a "moratorium on any one [higher education institution] changing functioning level, which degrees you can offer" (SN1, p. 10). This means that other associate degree-granting institutions in the state are not able to

add the Bachelor of Technology their degree offerings. In addition, OSUIT is not able to expand upon its own Bachelor of Technology degree offerings at this time.

The OSU system is made up of five primary campuses: OSU-Stillwater, OSU-Tulsa, OSU-Oklahoma City, OSU Center for Health Sciences, and OSUIT. OSUIT is situated within the OSU system as a technical branch campus of the primarily baccalaureate and graduate degree-granting system. Beyond the OSU system, the State of Oklahoma is home to 45 public two-year and four-year higher education institutions and branch campuses across the state, 14 private not-for-profit colleges, and 3 private for-profit colleges. In addition, Oklahoma has a system of 29 technology centers on 57 campuses that provide technical training to high school students as well as adult students. Technology centers do not have authority to award college credit, but can provide training on-campus that awards credits through partnerships with degree-granting institutions, as well as pathways for transfer to other postsecondary institutions.

OSUIT sets itself apart from other institutions in the OSU system and across the state with its mission to: serve as the lead institution of higher education in Oklahoma and the region providing comprehensive, high-quality, advancing technology programs and services to prepare and sustain a diverse student body as competitive members of a world-class workforce and contributing members of society. (http://www.osuit.edu/campus_community/mission.html, retrieved August 6, 2013)

Over the years, as degree programs were added to OSUIT's offerings, the choice was generally made to "focus towards high-end and emerging technologies" (BP, p. 3). Vocational technology programs (such as saddle making and boot making), even when they were initially started on the OSUIT campus, were "shifted over to the Career Tech system in Oklahoma" in order to allow OSUIT to "focus on more advanced types of training" (BP, p. 3). One institutional administrator described this degree program evolution, including the eventual adding of BT degree programs to OSUIT's portfolio, as "a logical step in progressing, being that we are a part of the university system" (BP, p. 3-4).

OSUIT's Current Students

According to the NCES' IPEDS College Navigator, total undergraduate enrollment at OSUIT was 3,995 in fall 2011, the earliest term for which data were available. Of these students, 22 were classified as "undergraduate transfer-in" enrollments. Examining enrollment patterns, 55% of students attended full-time and 45% attended part-time. Approximately 60% of undergraduate students were male, and 40% were female in fall 2009. A total of 50% of the undergraduate student body self-identified as White / Caucasian, 21% as American Indian or Alaska Native, 5% as Black or African American, 2% as Hispanic/ Latino, 0% as Asian, and 2% as Non-resident Alien. "Race/ ethnicity unknown" was reported for 19% of undergraduate students. In terms of age, 70% were reported as 24 and under, while 30% were 25 and over. A large majority, 91% of students, were in-state students, while 8% were out-of-state students and 1% were from foreign countries.

Of first-time, full-time students pursuing a bachelor's degree who began their studies in Fall 2010, 54% returned in Fall 2011, while part-time students had a 40% return rate. Of those first-time, full-time students who began their program in Fall 2005, 46% graduated or transferred out into another degree program within 150% "normal time" to complete their program. Six year graduation rates were higher for male students (34%) than female students (13%).

According to data the Oklahoma State Regents for Higher Education's Oklahoma Education Information System, in the 2009-10 school year, students at OSUIT accounted for 4,130 degree program enrollments

(students were enrolled in multiple programs simultaneously). Of those enrollments, 1,671 (40.5%) were non-degree seeking students, while 478 (11.6%) were undeclared. A total of 1,431 of the program enrollments (34.6%) were in AAS degree programs, 389 (9.4%) were in AS programs, and 161 (3.9%) were in BT programs.

The OSUIT website provides additional demographics based on a Fall 2009 enrollment profile (http://www.osuit.edu/admissions/demographics.html, retrieved August 6, 2013). According to this data, approximately 27% of students live on campus, while 73% live off campus. The majority of students list their marital status as single (85%), as compared to married (15%).

Comparison to Other Higher Education Institutions

According to one institutional administrator, OSUIT stands apart from other Oklahoma community colleges in regards to the quality of the technical degree programs that it offers. He described that:

> Oklahoma community colleges have really, for the most part, abandoned their technical/vocational degree programs. And I can understand the rationale for it because for the last 4 or 5 years, they've had declining revenues. And what are the more expensive programs to offer on a comprehensive college campus? It's those technical programs. It's much easier to offer lecture classes and more affordable, than to offer a class with high end computers or diagnostic equipment or dynameters for automotive.
>
> So Oklahoma, while it has a very strong career tech center for high school population and, yes, they do allow adults in those programs – has, for the most part, no comprehensive community colleges. The institutions across the state that call themselves community colleges, if you look at their curriculum, they're really junior colleges. They really are freshman, sophomore, academic transfer feeder institutions. (BP, p. 4)

The dearth of comprehensive community colleges with technical curricula was a source of concern for this individual, who questioned "the State of Oklahoma's ability to feed the workforce" need for well-trained workers with only OSUIT and the Career Tech Centers providing qualified applicants.

OSUIT administrators at the institutional- and program-levels also talked about how their program stood out from others due to their strong focus on employer involvement to create highly specialized training opportunities for students that readily prepare them for the workforce, often for specific fields or even specific employers. According to one institutional administrator at OSUIT, "we are stacking the deck. What we do on this campus is we are preparing students for specific occupational outcomes, often times with specific employers, which all but guarantee that the student has a job waiting for them after they graduate" (BP, p. 4). Strong connections to employers who have ready-made jobs waiting for students were referred to as "the secret of the success" at OSUIT (BP, p. 5).

The AB Degrees at OSUIT

In Fall 2004, OSUIT received approval from the Oklahoma State Board of Regents to offer a BT degree in Information Assurance and Forensics. Over the years, personnel associated with the program interacted with employers who were hiring students and graduates, and listening to advisory committee members, program administrators and faculty learned that while they were "serving [their] constituencies well in security, there are these other opportunities" as well (SN2, p. 22). Employers were looking for students with experience in software development, networking, and other areas. The faculty became concerned that "we're not responding to our stakeholders in a way that we need to" (SN2, p. 21), and they engaged

their advisory committee in discussions of: "Should we [make changes to the curriculum]? Should we not do it? What would the curriculum look like? What differences?" From these conversations the current structure emerged of an umbrella degree program in Information Technologies (IT), with four options in: (a) Information Assurance and Forensics, (b) IT Enterprise Management, (c) Network Infrastructure, and (d) Software Development. A program modification was submitted to the Oklahoma State Board of Regents and approved in 2011.

Developing into a Community College Baccalaureate (CCB) institution. The development of the BT in IT degree (as well as two BT degrees in Engineering Technology which came about at the same time) marked a new chapter in this history of OSUIT as an institution. Not only did the faculty for this degree program encounter the joys and challenges of developing a new degree program, they shouldered the responsibility of leading their campus to become a community college baccalaureate degree-granting institution. As described by one program administrator: "People are going to look at you differently. I mean, you're inviting a whole 'nother level of criticism… as a 2-year institution that is rolling out baccalaureate program" (SN2, p. 13). There were a number of issues that the institution, and the faculty of the BT programs in particular, had to work through in order to satisfy evolving institutional rules, accreditation requirements, and state policies. Some of these issues were anticipated, while others came up in the process of the transition, as shared by a program administrator:

> I think in retrospect, there are so many issues that you have to address when you roll out a baccalaureate program at a 2-year institution, and we knew some of those, and we probably were aware of some that maybe we didn't get addressed as fully as we wanted to before we rolled the programs out. But then, there's a whole host of questions that we weren't even asking ourselves. You kind of go along, and you stub your toe, and go, "Oh, my gosh, I guess we need to make a decision about that." (SN2, p. 13)

For example, when the BT program was just started, faculty asked questions as to how OSUIT would be viewed by the HLC, their institution's regional accrediting association. As a whole, the institution was still primarily focused on technical education, associate degrees, and certificates, and yet, it now offered three bachelor's degrees. What category would the HLC now put OSUIT in, and what standards would the institution be held do? The Higher Learning Commission communicated to the Information Technology that: "'You're a 4-year faculty member, and that's who you are.' [They are] recognizing that this is a baccalaureate program, so that's our identity here, even if the rest of the campus is a two-year institution," and even though the IT faculty teach both associate degree and bachelor's degree Information Technology courses (SN2, p. 12). This means that the Information Technology faculty and department (as well as faculty teaching bachelor's degree courses in the Engineering Technology department) may be measured by different criteria than those in divisions that do not offer bachelor's degrees.

Other examples of issues raised in the development of bachelor's degree offerings come from the process of seeking ABET accreditation (which is discussed in greater detail later in the Program Quality section of this report). ABET accreditation is concerned with the stability of faculty in a program area, traditionally looking to promotion and tenure as a way to ensure stability. In this case, OSUIT's institutional history and culture has a potential clash with accreditation requirements. A program administrator working with the BT in IT degree indicated that, as a product of OSUIT's history of being a trade school, the institution has no promotion or tenure policies and "[tenure is] one of those institutional things that the institution is not going to roll out, regardless of what ABET says" (SN2, p. 14). To pursue accreditation, other indicators were needed to demonstrate faculty stability. Evidence of succession planning and cross-training embedded into the program were demonstrated as policies the ensure program quality. Further, a program administrator pointed out that "most of the [faculty] who are here today, five of our faculty, have been here since 2002, so we're a fairly stable program area." Since 2002, two faculty members had joined

the department and only one faculty member had left. Providing this evidence, in lieu of tenure, has been sufficient to date, to satisfy questions of faculty stability from an ABET accreditation standpoint.

ABET accreditation also required a reduction in faculty teaching loads from 15 credit hours to 12 credit hours in order to assure time for engagement in scholarly activities. Additional requirements were also placed on necessary education levels and professional development for faculty. Further, some staff members, such as technical assistants, could no longer be funded using soft money sources.

Program administrators also noted a number of changes required for facilities and student services needed to support baccalaureate programs. Financial aid, for instance, had to be addressed quickly because there were no policies related to financial aid that would be provided to students of rank junior and senior. An additional consideration made by accrediting bodies was the requirement of more extensive library collections to support baccalaureate-level programs. Even fine details, such as the regalia graduates wear to distinguish them as baccalaureate degree graduates, had to be addressed.

Marketing the AB. The IT faculty members shared that they have had to engage in some educational endeavors to inform students, employers, state policy makers, educators, and other stakeholders about the new degree offering at OSUIT. As described by one faculty member:

> I think it [adding the BT degree] has been great for us, although… It seems weird when you say Bachelor's of Technology. A lot of people are, "What? What does that mean?" I don't know if there's a stigma, but there's definitely – if someone actually listens to what you say, a lot of times they don't understand or know what it is. (Faculty Focus Group, p. 2)

As a result, the IT faculty feel that they often engage in "a little bit of a marketing out push to let people understand what the BT is about and understand how it works" (Faculty Focus Group, p. 2). They describe that "it's the same courses [as other bachelor's degree programs]; it's just the way we do it is different… we're a practical, hands-on. Most of our class time is really dedicated to project type of coursework" (Faculty Focus Group, p. 2).

These informational conversations occur "annually" in many circles, and the faculty assert that the "biggest seller" of the quality of their degree program is "when our interns go into those brand new sites that have never worked with us, and they are performing from day one" (Faculty Focus Group, p. 2).

Curriculum Design. There are three degree programs available in Information Technology at OSUIT – and Associate of Science (AS), an Associate of Applied Science (AAS) and a Bachelor of Technology (BT). Within the BT, there are four options for specializing, which include: (a) Information Assurance and Forensics, (b) Network Administration, (c) Software Development, and (d) IT Enterprise Management.

The AS and AAS degree programs have many similarities. The primary difference between the two is that the AS degree program is designed to transfer directly to traditional bachelor's degree programs (e.g., BA, BS), and therefore has more emphasis on general education courses, while the AAS degree places more emphasis on technical, workforce-oriented courses that are in-line with OSUIT's historical focus. Table 24 provides as summary of the types of required courses in each program. The primary difference between the two programs is that AS degree-seeking students are required to take two science classes, with at least one lab course in an area such as Biology, Botany, Anatomy, Chemistry, or Physics. AAS degree students are not required to take a science course. However, those who continue on to the BT degree program will be required to take these science courses as a part of their bachelor's degree program. Students in the AAS degree program, rather than taking science courses, are required to complete additional IT Core classes in Database Systems and Script Programming. In total, the AAS degree program requires completion of 61 credit hours, while the AS degree program requires completion of 63 credit hours.

Table 24. Summary of the course requirements between the AS and AAS and IT degree programs at OSUIT

Course Type	Required Number of Courses		Required Number of Credit Hours	
	AAS	AS	AAS	AS
IT Core	8	6	24	18
IT Elective	2	2	6	6
Total IT	10	8	30	24
English Composition	2	2	6	6
Humanities / Social Science	5	5	15	15
Business / Communication	2	2	6	6
Mathematics	1	1	3	3
Science	0	2	0	8
Total General Education	10	12	30	38
College Cornerstone*	1	1	1	1
Grand Total	21	21	61	63

* OSUIT requires all students in associate programs to take a 1 credit hour course called "College Cornerstone" in which students "learn to use the leading edge technology available on campus, to become savvy, self-motivated learners and to assess their strengths as learners and technical high performers" (http://www.osuit.edu/academics/cornerstone_to_capstone.php retrieved July 31, 2013).

Admittance into the BT degree program in IT requires completion of an AAS degree or higher. In the past, the division between the AAS degree program and the BT degree program was not sharp in practice. In fact, prior to 2012, the AAS degree program was actually 74 credits in length, including a fifth semester in coursework that brought students into what is now considered upper-division coursework. This five semester program was considered "very viable" because it was "still a workforce-oriented degree" and it "allowed students pursuing the AAS to get a little more coursework so if they stopped [at the associate degree], they could go and be more proficient anyway" (SN1, p. 7). However, the Oklahoma State Regents raised questions about who was accessing upper-level course work at OSUIT. Part of the negotiations to allow OSUIT to be able to offer the BT degree was that students had to "have an associate's degree or higher to get into this baccalaureate program" (SN1, p. 5). Due to administrative debate over this issue, the AAS degree program was cut back to a four semester, 61 credit hour program, so that the associate degree could be awarded before students transition into the BT degree program.

That said, program administrators and faculty at OSUIT have worked hard to make the transition process from the AAS to the BT degree program as simple and "seamless as possible" (SN2, p. 20) in order to encourage students to continue by lowering barriers that students may perceive along the way. When students are enrolling in their fourth semester of coursework for the AAS degree, they are asked: "Are you interested in walking, or are you going to continue into the baccalaureate program?" (SN2, p. 20). Students who demonstrate interest in continuing to the bachelor's degree are given a one-page application form for the BT degree which asks for their contact information, the semester they plan to enroll in the BT program, the BT program that they are interested in, the degree(s) that they have received in the past, and their signature. Completion of this form is all that is needed on the part of the student for transfer into the BT degree program.

For students who have very few credits to take to complete their AAS degree (e.g., six credits), but would like to take a full-time load (which is 15-credit hours), may petition to take upper-division coursework while completing their AAS degree. A separate form would be required for this.

The BT degree program builds upon the foundation of the AAS degree program. Within in their technical coursework, students must choose among the four technical options (Information Assurance and Forensics, Network Administration, Software Development, or IT Enterprise Management). Within their option area, they take three major courses (nine credit hours), three technical electives (9 credit hours), and 19 credit hours of core coursework which includes an employment orientation, internship, project management course, and applied research and development course. Within the general education requirements, in addition to taking the two required science courses mentioned above, students take two courses (six credit hours) in mathematics, and three additional classes (nine credit hours) in other electives. This leads to a total of 121 credit hours for the BT degree – 67 technical hours, 53 general education hours, and 1 credit hour in the college cornerstone class.

Finally, it is important to note that OSUIT is a trimester institution, offering three 15-week semesters each year. One program administrator shared that it is "very typical" for associate degree-seeking students to "finish in just over a year, 16 months" (SN2, p. 16). Often, students can complete the BT degree within three years. OSUIT program administrators find that some higher education stakeholders are not pleased with the idea of three-year baccalaureate degrees. They highlighted representatives from their regional accreditation association as not supportive of this strategy:

> I have these visions of [a Higher Learning Commission representative] standing up talking about 3-year baccalaureates, and she really wasn't a big fan of them. Because she thinks there should be a steeping process, and take some time and let's not rob them of the opportunity to learn and stuff – which I fully agree. There's a liberal arts component in my background, too. (SN2, p. 16)

On the other hand, other OSUIT stakeholders see great value in the three-year baccalaureate degree opportunity that is provided by the trimester structure, particularly when the workforce focus and the needs of the specific student body are taken into account.

> People see it as a real advantage of our program, the students, employers, and others. Because you can finish a bachelor's program here in less than 3 years… It's seen by a strength of the vast majority of our stakeholders, save the HLC, who – and I understand. Do you want to rush through this? College is this time, right? But we're a very different institution. Our students are different. (SN2, p. 16)

Special Topics: Security Clearances. In the Information Assurance and Forensics degree option, students are required to complete an Oklahoma State Bureau of Investigation background check. The

IT degree program office provides the form to students, along with instructions for how to pursue the background check. Once the background check is complete, students return the form and the academic affairs unit on campus processes them because they have students' social securing numbers. If a concern is raised by a background check, the results include a 1- or 2-page explanation from the courts describing what was found. For admission to the IT degree program "basically the line is drawn at a felony. If you have a felony conviction, you're not admissible" (SN2, p. 29). The reason for drawing this line is that the security field is known for being very strict on this point – "you're unemployable in security if you have a felony" (SN2, p. 29). Encouraging a student to spend the time and money to pursue a degree in this field without strong opportunities for employment after graduation is viewed as inappropriate.

This approach to the background checks is supported by CSEC (the CyberSecurity Education Consortium across the State of Oklahoma) – "the deal was that we would do this. All of us would do it" (SN2, p. 29). At first OSU's legal counsel questioned the decision, stating that the institution was "not liable if [students] go out and do something bad." Yet, the faculty embraced it as more of "an advisement issue. Why would we allow a student to go get a degree that they can't use?" (SN2, p. 29). One IT program administrator shared that their industry partners appreciated the decision, saying that "and this is their terminology, they felt like it lends some integrity to the program" (SN2, p. 29).

Articulation and Transfer

One program administrator spoke of the relationships that OSUIT has with other associate degree-granting institutions for their students to transfer into the BT in IT degree program, saying: "I'd love to say that we're the best thing since sliced cheese, but the reason we have so many two-year institutions contacting us is because they can't find another partner that's similar to us" (SN2, p. 17). Having a bachelor's degree that focuses in information technology is simply rare, and it offers opportunities for the transfer of associate degree credits that do not necessarily fit more traditional and common computer science and computer engineering bachelor's degree programs. This makes OSUIT a very attractive partner for many associate degree-granting institutions – "they want to send their students here, because there's not another partner that has a similar applied baccalaureate-level program" (SN2, p. 17).

OSUIT, however, has been strategic in the way that it has built partnerships and articulation agreements. Rose State College (RSC) and Tulsa Community College (TCC) were described as natural first steps "because we have physical presence there" (SN2, p. 17). A partnership also exists with Oklahoma City Community College. As expressed by an OSUIT program administrator: "We have an articulation agreement that we developed. We just never had anyone sign it. But we use it. I guess we should ask some president some place to sign this. But it's working for us" (SN2, p. 17). A formal agreement is also held with Richland College in the Dallas Community College System, and OSUIT is working on articulation agreements with St. Louis Community College, Manhattan Area Technical College, and Butler Community College in Andover, Kansas. Many of these campuses would like to see arrangements "something similar to what [OSUIT does] with Tulsa Community College and Rose State College" (SN2, p. 17), which includes teaching bachelor's degree courses on the community college campuses. Yet, OSUIT has not begun to pursue those type of arrangements. They are waiting "until things settle down… internally" (SN2, p. 17) before considering the opportunity to cover more geographic ground in this way, as their institution has recently hired a new president and there have been recent changes on the Oklahoma Board of Regents staff. Politically, it is important to "see how that shakes out" (SN2, p. 17) before entering into deeper relationships with additional campuses.

Partnership with Rose State College (RSC). OSUIT also has a partnership with RSC to offer the upper division coursework for the BT in IT degree program on the RSC campus. This partnership has been in place since 2005/2006. Classes at the RSC campus serve a "predominantly nontraditional student population" (SN1, p. 2), therefore classes are offered in the evenings.

Faculty offering the classes are hired as adjunct faculty by OSUIT to offer the BT degree courses, yet many of them also serve as faculty at RSC. Additionally, OSUIT program administrators stressed the importance that the RSC faculty are "very much known quantities" to the OSUIT faculty (SN2, p. 18). The RSC faculty "have gone through the exact same training and degrees and stuff that [OSUIT] faculty have. [They] are graduates of the University of Tulsa's master of science, computer science program; [and have] been of CSEC [the CyberSecurity Education Consortium] for 10 years now" alongside the OSUIT faculty (SN2, p. 18). All of these characteristics lead to a sense of confidence that the OSUIT faculty "know pretty well what [the RSC faculty] are doing" (SN2, p. 18). They have built up close relationships and a sense of trust and respect over the years that greatly facilitates the articulation and course-sharing partnership.

The original plan was to hire a full-time OSUIT faculty member who would be stationed at RSC. However, "like a lot of programs, enrollment has ebbed and flowed" (SN2, p. 19). As a result, the OSUIT program administrators feel they "needed the flexibility that adjuncts provide" (SN2, p. 19) so that if enrollment drops they are not left with a full-time employee stationed 100 miles away from the Okmulgee classes without enough students to serve. However, the idea is still on the table for the future. As one program administrator suggested: "if it ever got to a critical mass and we could justify that, then we would do that" (SN2, p. 19).

Partnership with Tulsa Community College (TCC). OSUIT has had an articulation agreement with TCC since they implemented the BT in IT degree program. Only recently, they "expanded the program" to include offering upper division, "hands-on coursework" on the TCC campus (SN1, p. 3). Half of the faculty members who work at the OSUIT campus in Okmulgee live in the Tulsa area, which makes staffing the courses held at the TCC campus with OSUIT faculty quite simple – "if you're teaching Tuesday evening, that's your day to be in Tulsa" (SN2, p. 18).

Partnerships with Technology Centers. OSUIT holds Cooperative Alliance Enrollment Agreements with several Technology Centers across the state of Oklahoma such that students "may apply credits directly to the OSUIT AAS in Information Technology degree" for coursework completed at the Technology Centers. During our site visits, we visited with two Technology Centers to learn about these agreements – Central Technology Center and Tulsa Technology Center.

One OSUIT program administrator mentioned that when the crosswalks were first being developed between OSUIT and the Technology Centers, "there was a lot of angst [among other 4-year institutions] about, well, should a person be able to get credit for a course that they take at Central Tech, bring it to OSUIT and transfer to a 4-year institution? It's really a technical course" (SN2, p. 31). However, the OSUIT faculty came to think that once IT skills were learned by students, they were "in the bloodstream. Who knows whether it's a technical course? Did they take it here? Did they take it there?" (SN2, p. 31). At this point, they saw value in providing credit to acknowledge the skills and knowledge gained.

The relationships between OSUIT and the Technology Centers have taken time to build. As described by one program administrator, "When we created the [IT] division [at OSUIT] in 2001, we had zero relationships with the technology centers. And, you know, relationships are things you've got to work on, and it takes a long time" (SN2, p. 33). During our site visits in May 2012, the partnerships with

Technology Centers were described as begin "of varying strength" across the state, yet having come a very long way in many cases. The relationships with Central Technology Center (Central Tech) and Tulsa Technology Center (Tulsa Tech) were highlighted as particularly strong.

> They trust us; we trust them. We've known each other a long time. We see each other a few times a year. And, they invite us to come and give presentations or to facilitate some kind of sessions. … And so, we've started going to the ones that we think would be good feeders for us… because we're trying to show people, this is what we do. So when you come to our campus, you're going to do this kind of thing.
>
> Honestly, we don't even go to the counselors. We don't go to the front office. We get there, we say, "Hey," and we walk on to the classrooms. We've been there a hundred times. We've got that relationship. We hang out. It takes a long time to get there. (SN2, p. 33)

Out of these relationships, faculty and instructors at the institutions have been able to agree upon a set of course articulations. An example crosswalk of courses was provided between courses provided at Central Tech and OSUIT's AAS degree program in Information Technology. Table 25 provides a summary of the total number of credits that may be transferred between the two institutions. Students can essentially bring 18 total credit hours of IT core and elective coursework from Central Tech to OSUIT, which accounts for nearly 30% of their total credit hours required for the AAS degree. Additional advising notes are provided to students informing them that they are required to achieve a "C" or higher in all major coursework and to maintain a minimum of a 2.5 GPA. Additionally, OSUIT requires that "at least 15 of the final 30 hours applied toward the degree, or at least 50 percent of the hours required in the major field" must be completed through OSUIT (Central Tech/ OSUIT IT Partnership Program flyer).

Table 25. Summary of Course Transfer between Central Tech and OSUIT

Coursework Type	Number of Credits Required for OSUIT AAS Degree	Number of Credits that May be Transferred from Central Tech
IT Core Coursework	24	12
IT Elective Coursework*	6	6
College Cornerstone	1	0
General Education	30	0
Grand Total	61	18

* If a student intends to pursue the BT in IT, three credit hours should be applicable to one of the BT options.

The Technology Centers serve a variety of students, with "high school students and adult students all sitting in the same classes and doing the same stuff" (SN2, p. 22). High school students are typically bussed in for half-day programs, while adult students may choose a half-day or full-day option.

Enrollment and Student Demographics

The AB Pathway. When asked about enrollment and student experiences, one program administrator shared that OSUIT faculty "refer to the IT programs" as a group because they "really kind of see it as this large continuous program" (SN2, p. 19). The total number of students is used as a gauge for program health and success – "AS will go up, and AAS will go down. And it's kind of fluid" (SN1, p. 19), but at the end of the day, they are most concerned about the performance of their three degree programs as a whole.

In Fall 2011, OSUIT's AS, AAS, and BT degree programs collectively enrolled approximately 235 students. Faculty and program administrators of the IT degree programs at OSUIT have the impression that, in the past, their associate degree programs were viewed by students as terminal degree programs. As expressed by one program administrator:

> If you had asked me in 2003/2004, at the time, talking to our students, the AAS was still very much a terminal pathway for a lot of students. "This is why I'm here. I'm here to get the Associate's in Applied Science, stop, and go to work." (SN2, p. 19).

However, in more recent years, faculty and program administrators now have the sense that the vast majority of their associate degree students continue on to pursue the BT degree. As expressed by an IT program administrator:

> It's like, "Well, I'm already on this pathway. I don't have that much longer to go. One of the four semesters is an internship. I think I'm just going to stick around and get this done." Because part of that is the ease of it, I think.
>
> And part of it is what they're seeing when they go to Monster [the job posting website], and what they hear when they talk to employers… A lot of the employers we talk to are saying, "We're really looking for baccalaureate-level people." Or, if you want to be a supervisor at Company ABC, you're going to have to have a baccalaureate degree.
>
> And students are saying, "Well, do I want to go to work for a while and then try to work on my baccalaureate degree, or do I just want to get it while I'm in the pipeline already?" I think there's kind of a path of least resistance almost because a lot of them feel like the baccalaureate is where they have to be or need to be…
>
> [And] very rarely will students say "I want to go and get a degree in computer science or telecommunications" or something that we don't offer. (SN2, p. 19)

The faculty echoed this sentiment, with one faculty member expressing: "Almost all of them now stay and continue with it [the BT degree]" (Faculty focus group, p. 2).

Students come to the AS, AAS, and BT degree program with a wide variety of skills and preparation. As one faculty member described:

> I've had students in my first-semester classes that have problems with what a filing folder is, and some of them have problems with just running a computer. And then, we have some of them that come in that have been running a computer for 15 years. (Faculty focus group, p. 11)

Some students come into the program needing to take "all of the developmental coursework" including math, reading and writing. Others require only a single course and "typically if it's just one of the pieces, it's usually math" (Faculty focus group, p. 11). The need for remedial education was viewed by faculty as a nation-wide issue, not an issue that is specific to OSUIT. Making it through the developmental

coursework and being successful in the IT curriculum was said to "depend on the willingness of the student to work hard" (Faculty focus group, p. 11).

BT in IT Degree Program. OSUIT provided historical enrollment data trends related to students enrolled in the BT in IT degree program. The data provide an interesting glimpse at how the population of students in the IT program has changed from 2001 to 2011. According to these data, over this decade, the average age of students enrolled in the program increased from 22 in 2001 to nearly 27 in 2011. Additionally, the percentage of students living on-campus decreased from greater than 45% to less than 20% in this time, average student load decreased from nearly 15 credits per student in Fall 2001 to slightly greater than 11 credits in Fall 2011. In this time period, there has also been an introduction of "alternate delivery coursework," including online, hybrid, blended evening and weekend courses. In the 2001-2002 academic year, no courses were offered in these alternate formats. In the 2010-2011 academic year, nearly 45% of courses were offered in alternate delivery formats.

These numbers appear to indicate that the population of students in the IT program have shifted in the past decade, from a younger, more traditional college student population, to a population that has more adult students who attend part-time and live off-campus. As described by one program administrator, in reality:

> What's happened is it's not like our entire student population have all kind of shifted together; it's been a bifurcation of our student population. So we still have a fairly traditional student population here [on the Okmulgee campus], from 7:30 to 4:30, but then we have all these other students out there, right? So they're in Midwest City and Tulsa and elsewhere. And so, we've seen a pretty dramatic shift in terms of that. (SN2, pp. 15-16)

During our focus group with IT faculty, some faculty members also attributed this increase in the number of non-traditional college students returning to pursue the BT degree to "the economic situation that we've had for the past few years" (Faculty focus group, p. 6). When jobs were lost, these students turned to OSUIT to "[be] retrained and [get] experience in a different area than they've ever been in before" (Faculty focus group, p. 6). The BT in IT degree program was also thought to have benefited from a campus-wide "initiative for the returning vets to be able to try to target them and pull them into the programs" (Faculty focus group, p. 6).

As reported by an IT program administrator, approximately 75% of bachelor's degree students in OSUIT's IT program "complete their programs without any loss of continuity" (SN2, p. 16), This means that they transition to the BT degree program directly from the associate degree program, without taking a break in between.

Faculty Roles and Positions

The Information Technology program at OSUIT has seven full-time faculty members. Five of those faculty members were a part of the department when they implemented the BT degree program, two came subsequent to the implementation of the BT degree program. Only one faculty member had left since the implementation of the BT degree program. This continuity of faculty is expressed by members of the program administration as a point of pride, demonstrating commitment to the program and a belief in the direction that they have taken as a group.

Full-time faculty members teach 12 credit hours (four classes) per term. All faculty members hold at least a Master's degree, as required by ABET accreditation. However, not all of their graduate degrees are in technical fields. Those with Master's degrees in education, supplement their education with justifications "through experience and/or certification" (Faculty focus group, p. 5).

The only adjunct faculty members in OSUIT's programs are those who teach BT classes offered on the RSC campus, except in the case of "unusual enrollment" when extra course sections need to be added to handle the additional load (Faculty focus group, p. 5).

Future Directions

Looking forward, the IT department at OSUIT is starting to ask some challenging questions about what may be the optimal size for their degree program. They recognize that "there's always some pressure to increase a certain percentage every year," yet there is a balancing act to engage between the benefits and challenges of growth.

> We've begun to talk internally about how big should we be. How big really should our program be? It's not just because we want more state appropriation or more tuition revenue, but at what point do we need to start talking about changing our admissions processes?
>
> Right now, if you talk about this as an undergraduate program, we're one of the biggest computing programs in the state. We're certainly bigger than the computer science programs at our research universities.
>
> And we haven't totally figured out what the mechanism is that will try to find out, are we continuing to serve [our stakeholders well]? As long as the students are getting the jobs that they want to get, and employers are getting the employees they want to get, I guess that works. (SN2, p. 28)

There are a number of challenges at play that the IT program administrators and faculty are attending to. While growth is helpful for bringing in additional funds and resources, there is a need to make sure that students are able to find internships and full-time positions after graduation. It does not serve the students well to over-saturate the local market with graduates who cannot find placements. OSUIT faculty also need to ensure that students continue to receive high-quality educational experiences, and to develop the skills that employers expect so that interns and graduates have the potential to perform well on the job and met employer needs. Another example concern is that if the decision is made to limit growth and more students would like to enroll than there is space to admit, how would admissions decisions be made at an institution which has historically held an open enrollment policy?

Beyond the practicality of size and number of students, faculty members and program administrators in this department also anticipate asking the question of: "how can we get this special product to the people who need it, wherever they are?... If this is something you say, 'This is what I want,' then how are we going to make that happen without giving up the quality?" (SN2, p. 35). This brings the faculty back to the questions regarding balancing residential classes with online course delivery. Some of that tension can be heard in the following reflections from an IT program administrator whose comments reflect somewhat limited knowledge of the curriculum:

> One of the benchmarks of the institution is we're a hands-on application folks institution.
>
> It doesn't matter, in my opinion, where you are when you're learning how to write webpages. What difference does it make if you're sitting on an aircraft carrier, if you're in one of our classrooms? You're looking at code, you're compiling.
>
> But hardware – How do you do that in a quality way without having access to it? At least even part time, the blended format, something. How do you do that? And there are lots of institutions that offer hardware fully online. Well, they're better people than I am if they're figuring out how to do that without giving up something.

> And so, I see that the institution, the program area, we've got set what we need. We've got the strategic partnerships with Tulsa Community College and Rose State College. We're good there. I can see some other partnerships forming potentially someday in other states, in which we'll do something similar.
>
> But I also think a big piece of our future is going to be figuring out that residential component. And it's just a real change for us. It's a real change for faculty to start thinking differently. It was a little bit of a change to go from seeing the students 3 days a week to seeing them 1 day a week, or 5 times in a semester, on the weekend. Well, now I'm asking them, imagine all the hands-on part of your course stacked up in two 8-hour days. What's that going to look like? And, you know, it just takes a while to bring people along for things like that. But I think that's the kind of thing that we're going to see.
>
> Fortunately, one advantage we have is [that we are] technology faculty. So [we're] pretty comfortable. (SN2, p. 35)

This transition to blended and online education is explored further in the Educational Significance section of this report.

Challenges and Areas of Concern

Cultural shifts associated with offering baccalaureate degrees. The program administrators and faculty at OSUIT have experienced that being a "two-year institution that happens to have some baccalaureate programs" (SN2, p. 11) has required them to make some "mental shifts" in how they think about their work. They found that when a bachelor's degree program was added to the Information Technology area, ultimately "you can cast an umbrella over this area. You're a baccalaureate program, period" (SN2, p. 11). Even though some individual faculty members may have viewed themselves as primarily teaching associate degree classes and serving an associate degree population, external stakeholders (e.g., accreditors, Regents) began to treat them as faculty members within a baccalaureate degree program and sending the message that "you'd better act like one [because] that's how we're going to look at you" (SN2, p. 11). Changes had to be made rapidly, such as reducing faculty teaching loads from 15 credit hours to 12 credit hours to make room for scholarly activity that would now be expected by accrediting agencies and other external stakeholders as "a sign of engagement in your field" (SN2, p. 15).

Scholarly activity at OSUIT is "broadly defined" to include both traditional research and pedagogical-related research, with the latter being "much more oriented to the kind of things that [OSUIT] faculty do" (SN2, p. 15). Encouraging the OSUIT faculty to engage in scholarly activity has been challenging because it required a change in cultural norms. As described by one program administrator:

> That's just a cultural – it's just taken me awhile. Because except for two, our faculty were hired when we were an associate degree-granting institution, actually no expectations for anything like that. Bringing them along has been something that probably if you'd asked me 8 years ago, it's probably taken a lot more time and effort than I anticipated." (SN2, p. 15)

Progress has been made in some areas – "Today, we do a great job of presentations" (SN2, p. 15). However, there are other areas where room for growth is still perceived – "We're still not where we need to be in terms of publishing" (SN2, p. 15).

Increasing access while maintaining quality. When talking with faculty for the BT in IT degree program at OSUIT, we heard some reflection of concerns about balancing program quality with new delivery models and strategies to make the program more accessible to underserved student populations – much like what we see in the applied baccalaureate literature. Examples of changes in delivery models and

strategies included increasing the number of courses that are offered in an online format, offering courses in a condensed eight-week format, offering courses in a tri-semester format, and removing pre-requisite requirements from courses to ease enrollment barriers. Although these strategies, on the one hand, aim to helping more students enroll in the AS, AAS, and BT programs in Information Technology, one faculty member shared concerns about some unintended consequences that may have a negative impact on the students, saying that many students "have a huge problem being able to absorb the vast amounts of information they must receive and digest in the tri-semester format" (0531, p. 1) and that faculty simply "can't cover all the material" (0531, p. 3) that needs to be taught in an eight-week course. There was also a concern expressed that students who come to a class without the pre-requisite skills will quickly fall behind "because they do not have the tools" (0531, p. 4) to succeed. In the end, this could be viewed as an unfair practice to the students – to have students continuously come back to classes, incurring the time and financial costs when they are unable to be successful. It is unclear, without examining outcomes data, how program quality is being affected by these program delivery models and strategies. However, hearing both supports and concerns expressed by faculty in the field brings the debates in the literature to the forefront, and highlights the importance of pursuing outcomes data to support this research.

Human resources misunderstanding the degree. Across the state of Oklahoma, OSUIT offers the only bachelor's degree specifically in Information Technology. The "traditional research universities" in the state offer degree programs in areas such as computer science or management information systems. One struggle and frustration mentioned by IT program administrators and faculty at OSUIT is the misunderstandings that they encounter when working with human resources (HR) professionals in respects to helping their students and graduates seek employment opportunities. One program administrator described the situation as follows:

> The problem we have is HR people don't know the difference. The industry, the practitioners, the IT leaders know, and they understand. And those we work with totally get it. And for many of them, we're where they come to get people. But we have an advisor who continually reminds me that we're the best kept secret. And that's a real frustration of mine, because how do we get better market penetration?

Currently, the faculty experience that employers "predominantly find out [about OSUIT's BT in IT degree program] because they have someone go to work for them, or they rub up against someone who [graduated from the program] – and they're impressed by their skill sets" (Faculty focus group, p. 4). Yet, this offers only a very slow process for growing networks and contacts. The faculty would like to expand their employer network development strategies.

Sharing What Works: Program Quality

Adherence to recognized standards.

ABET accreditation. Becoming accredited by the Accreditation Board for Engineering (ABET) was a requirement that came up in the negotiations between OSUIT and the OSU system for allowing OSUIT to award baccalaureate programs in technology and engineering fields. ABET, recognized by the Council for Higher Education Accreditation (CHEA), is an accreditation body that allows programs to receive a recognized program quality rating through a voluntary process. ABET accreditation is an 18-month process, and involves assessment of the program and its outcomes, along with on-site visits and self-study reporting.

Seeking ABET accreditation as an applied degree program, particularly in the early years of the program when the degree's sole focus area was in Information Assurance and Forensics, offered unique challenges.

To begin, there was debate regarding where OSUIT's program belonged within ABET's organization. As described by one program administrator:

> There was [an ABET] conference coming up, and my then counterpart over in Engineering [Technologies] and I, we went to this conference. At the time, [ABET wasn't sure where IT belonged.
>
> The TAC, which is the Technology Accreditation Commission, was saying, "Come over here. It's going to be over here." And the Computing Accreditation Commission people, "No, no, it's going to be here, Computing." Finally, I just went to the Computing meetings, and it ended up in Computing. And so, Computing has computer science, information systems, and IT. (SN2, p. 13)

As OSUIT engaged in the accreditation process, they found that they became a "pilot for ABET for IT" (SN2, p. 13). One program administrator describe the process as "very untidy… we were being looked at through the lens of computer science and information systems. They recognized that there were some differences, but they weren't exactly sure what those were. And so, it was a very messy process" (SN2, p. 13). Despite the challenges along the way, OSUIT achieved ABET accreditation for its BT in Information Assurance and Forensics at Okmulgee, Tulsa and Rose State College campuses in October 2005. ABET accreditation is granted for a limited number of years, not to exceed six, and ABET policy prohibits public disclosure of the period of years for which a program is accredited. The list of accredited programs is published annually by ABET on their website (www.abet.org). The ABET website lists OSUIT's BT in Information Assurance and Forensics degree program as being accredited from "October 2005 to present" by the Computing Accreditation Commission. The date of the next comprehensive review for this degree program is set for 2012-2013.

At the time of the research team's visit to OSUIT, the Engineering Technology program had not sought or received ABET accreditation. According to an administrator within that program, "[seeking accreditation] was hard for us to swallow, because, to tell you the truth, we didn't see the ROI (return on investment) in it. None of our industry partners said 'you better have ABET accreditation or we're not going to hire'" (DH, p. 14). However, ABET accreditation was a condition promised by institutional administration when OSUIT was approved to award baccalaureate degrees, so program administrators noted that they were still working through the process of accreditation, and simultaneously working with institutional administration and the Oklahoma Board of Regents to see if it is possible to seek alternative accreditation or remove the requirements for ABET accreditation on the programs where it is not seen as necessary by employers.

Collaborations to strengthen quality and effectiveness.

Industry advisory committee. OSUIT's IT programs have been supported by an industry advisory committee since 2001, according to one program administrator. The Spring 2012 advisory committee consisted of 33 individuals who work in the IT industry, primarily in Oklahoma. Five members (15%) of the advisory group were female. While their levels within their organizations vary, a program administrator noted that they seek the representation from high-level employers – "They are IT leaders. So they are director- and CIO- (chief information officer) level folks involved" (SN2, p. 20). This push for higher-level advisors came from a need to have individuals who knew about their organization's needs for employment, particularly interns and other entry-level positions. According to one program administrator, "when we first created the program, we had technicians, all the way from technicians to presidents of IT companies. And what we discovered was, that's not who we need; we need decision makers" (p. 20). Decision makers are important to have on the advisory committee because they are the people who can mobilize resources and opportunities quickly. As one program administrator shared:

> A CIO can do everything for me that a technician can, including getting me a technician. A technician cannot do everything a CIO can. A CIO can say, "We will hire three interns this summer." Boom. End of conversation. Got three interns going there. Or, I have 50 servers that I can send you in the next 2 weeks. A technician can't do that. They have to ask somebody. (SN2, p. 20)

A summary of the positions held by the Spring 2012 industry advisory committee members can be seen in Table 26.

Table 26. Summary of Positions Held by Industry Advisory Committee Members

Position Titles	Number of Advisory Committee Members
Founder / President	3
Vice President	5
Chief Executive Officer / Chief Information Officer / Chief Operating Officer	8
Director / Unit Head	6
Administrator / Manager	7
Supervisor / Senior IT Personnel / IT Liaison	3
Position Unclear	1

Meetings with the industry advisory committee occur twice a year – near the end of the fall and spring terms. Based on meeting minutes from the May 2011 and November 2011 meetings, our site visit team could see that approximately 20-25 industry advisors attended each meeting. Also participating were all IT faculty members, as well as the current OSUIT President, and in each session time was made over the lunch hour for current students to interact with the industry advisors. In each session, the OSUIT President shared a "State of the Campus" address with the industry advisors. Discussions were engaged around topics such as strategic planning for the degree program and internships for international students. Finally, specific action items were identified in the advisory committee meeting minutes, with both faculty and industry advisors responsible for follow-up.

Professional development and community involvement

K-12 outreach. OSUIT program administrators noted a number of outreach activities in which the BT in IT faculty and program staff engages. These events are primarily geared toward high school and Career Tech center students, although some programs engage younger students as well.

Some events are designed to increase the recruitment of women into the degree program. A day-long "Women in Technology" event is facilitated by OSUIT's only woman IT faculty member, along with female members of the IT industry advisory committee – "we have some very high-level female IT leaders from the area" (SN2, p. 34). The event allows students to get exposure to employment options and to talk to other women in the field. A second event, called "Technology Transformations," brings Girls Scouts to campus to engage in technology-related activities.

OSUIT also hosts the Business and Professionals of America competition that serves as an "indirect recruitment opportunity" for the IT department (SN2, p. 34). Students come for the competition, yet they also gain exposure to and familiarity with campus.

Additionally, using funding from employers such as Google, OSUIT IT faculty offer professional development workshops for high school computer teachers. These workshops provide "hands-on sessions relating to new and emerging technologies," as well as trips to industry sites to interact with employers and "to talk about trends and careers and other things" (SN2, p. 34). In addition to providing a service to teachers who "really have challenges in getting professional development funding," one IT program administrator expressed that he believes their program has "seen some pretty consequential dividends" in terms of student enrollments in the program (SN2, p. 34). He expressed that teachers return to their schools and share with their students: "Hey, there's this place in Okmulgee that I never heard of, but you need to go check it out" (SN2, p. 34).

Sharing What Works: Educational Significance

Individual and societal needs addressed by the program.

Academic and learning needs. OSUIT implemented the BT in IT degree program in order to better serve transfer students who had begun their college experience with an Associate of Applied Sciences. As described by one program administrator:

> The reason we did it, we had a number of students who were interested in transferring, but the Associate in Applied Science at least in Oklahoma – I understand some states are friendlier about that – but it's just literally we're going to pick what we want, and that's the end of that discussion.
>
> We felt like we were serving the students who were interested in transfers, particularly local students who were interested in transferring. Obviously that problem diminished significantly and we moved on our own baccalaureate degree because now most of the native students will stay here. Not all of them. Occasionally a student will exercise that opportunity, that option, but most of them will stay here. (SN1, p. 5)

AAS degree graduates who chose to stay at OSUIT to complete a BT degree in Information Technology experience the benefit of all (or nearly all) of their associate degree credits transferring and applying toward graduation for their bachelor's degree. This is not necessarily the case for those who seek a bachelor's degree elsewhere, and provides an advantage in terms of decreasing time and expense required to obtain the bachelor's degree. This creates an opportunity for graduates of OSUIT's AAS degree program in IT that would perhaps not exist otherwise – "our bachelor's program is it really gives a pathway to some previously underserved populations" (SN2, p. 18). The faculty experience that students express a sense of relief when they find out about the BT in IT degree option, saying ""Oh! So I actually can do something with this besides get a position" (SN2, p. 18).

This idea of creating transfer opportunities for students who may not otherwise have access to them was echoed by and OSUIT institutional administrator who spoke about applied baccalaureate degrees more generally. He shared that, in his experience:

> [Applied baccalaureate degrees] opened up doors for so many students at the community college level, you have a lot of nontraditional students.
>
> You have students that are coming back after an extended period of time, and their first introduction may be occupational in nature. Just to retrain, to get my skills up where they need to be. I want to get a higher level job, a better paying job. So they are attracted into these vocational programs, but lo and behold they realize, you know, this isn't half bad. I kind of like being a student. I like going to school. Wouldn't it be cool if I could get my bachelor's degree and make even more money and take my career even farther?
>
> Without these bachelor of applied technology degrees, the doors shut on those kind of students. It does become a terminal degree. But if you can do these inverted degree programs at 4-year colleges, then it does create a lot of great opportunities for some very talented students that would not have a whole lot of other opportunities otherwise. (BP, p. 2)

From this administrator's perspective, the design of applied baccalaureate degrees, specifically the BT in IT degree at OSUIT, allows students the ability to work toward a vocational degree with real workforce benefit, but also allows them to continue into a baccalaureate program seamlessly if they decide to continue to move up the educational ladder.

Members of OSUIT's BT Industry Advisory Committee extended these reflections on how applied baccalaureate degrees serve student populations who are not served well by traditional bachelor's degree programs at four-year colleges and research universities. One industry advisor shared that:

> I feel like the applied baccalaureate programs are a great way for people where they've been displaced to gain if they want to move direction in terms of their career, a great way to provide that kind of capability for individuals. It's a great way for people that may not have an opportunity to get a degree from a large university because they're working or they're doing other things. … it's a great way for people that may not have had an opportunity or would have an opportunity to attend the large state university or private university, to obtain a baccalaureate degree. (Industry Advisor B, p. 3)

Industry advisors also spoke of "first generation college students" for whom going away to college "a big experience and maybe more than they can afford and more than they can just adapt to" (Industry Advisor A, p. 4). Offering the applied baccalaureate in a primarily associate-degree granting institution represented "an opportunity for some of those folks to be able to work toward that bachelor's degree in an environment and at an institution that is more suited to them" (Industry Advisor A, p. 4).

Industry advisors also hypothesized that institutions like OSUIT were well-suited to serve non-traditional student populations with applied baccalaureate degrees "because of its history and because of the school that it is; it attracts a certain type of student" (Industry Advisor C, p. 12). These students prefer practical, hands-on learning, and struggle "bridging the gap" to B.S. degree programs which "tend to be much more conceptual" (Industry Advisor C, p. 12). This industry advisor shared that:

> I definitely think that in the applied program, you're definitely going to have a higher rate of success among people who learn better with concrete examples, and don't do well with theoretical information than you will in the traditional program. (Industry Advisor C, p. 13)

In this sense bachelor's degree programs at institutions like OSUIT offer "a great complement" to traditional bachelor's degree program offerings, where there is perhaps "a different charter for the applied baccalaureate versus the traditional degree" (Industry Advisor B, p. 3-4). Rather than learning theoretical aspects and foundations of computer science, applied baccalaureate students "want to learn a programming language that makes them marketable immediately as they walk out the door" (Industry Advisor B, p. 4).

Other industry advisors stressed the benefits of how the curriculum of the applied baccalaureate degree is "much more practical and useful" (Industry Advisor A, p. 3) than traditional degree programs. As expressed by one industry advisor:

> In contrast to your traditional programs, I feel like traditional programs almost go out of their way to abstract the information, to be information for knowledge sake. … I went through school – it seems like there's almost this willful intent to not acknowledge that you're being prepared for the workforce. …
>
> In an applied program, it's not only acknowledged, but it's embraced. "Hey, this is preparation for what's going to come after this." Right? So we actually want to talk about what happens in the setting of a job, and we want to talk about what the structure of the organization is. And we want to talk about why what you're doing is valuable to that organization and how it relates and how it supports that organization. So it really connects the dots. (Industry Advisor C, p. 3)

This Industry Advisor went on to describe how this pedagogical focus translates into student performance when they transition to the workplace, saying:

> I've hired a lot of people right out of traditional programs, where they don't – they understand language syntax, or they understand how to configure a routing table, or they understand how to build a network, but they don't understand why, or the context of those skills in what you're doing in the workplace. Because that's never been discussed in their academic pursuit.
>
> And I think that's a key difference in the applied program. There's not only an acknowledgement, but it embraces the fact that the goal here is for you to go out and work. (Industry Advisor C, p. 3-4)

There was some sense among the industry advisors that we spoke to, who shared that that this gap between the applied and traditional bachelor's degrees existed because the end goal for the degrees differed. As described by one industry advisor:

> Part of the role of the traditional bachelor's degree is to also prepare you for an advanced degree – Master's, PhD, to head you down that path. The portion of it that's focused on furthering your education and that takes away from the time and the ability to focus on practical application. (Industry Advisor A, p. 4)

Ultimately, for one industry advisor the conversation about academic degree attainment came down to a question of encouraging individuals to stretch to their full potential. He shared that:

> What I would be looking for is how do I move people up the spectrum? How do I encourage more high school graduates to pursue an associate's degree? How do I push people who have associate's programs to get into the bachelor of technology or into the bachelor's of science? How do I take the bachelor's of science folks and say stay, get your master's degree?
>
> In other words, you're kind of moving people up the ladder. Because of people's personal circumstances and their individual capabilities, you're going to have people all along the spectrum. So how do I continue to move bar for all of those things? (Industry Advisor, p. 13)

Economic and employment needs. In a focus group, industry advisors to OSUIT's BT in IT degree program discussed how the field of Information Technology had changed over the past decade. They shared that 10 years ago the professional support tier of information technology was "not necessarily seen as professional roles" (Industry Advisor D, p. 7). However, the field has now reached "a level of sophistication" (Industry Advisor D, p. 7) that demands higher education and professionalization in this area. With the current level of professionalization, the field is moving toward a requirement of seeking entry-level professionals with bachelor's degrees. Associate degrees are no longer be viewed as sufficient training for these positions, according to many employers. As one industry advisor explained:

> At [our company], there would not be a distinction between traditional bachelor of science and the applied. They would be looked at the same way, but there would be a difference between the associate and the bachelor's. We have a lot of our positions that say a bachelor's degree is required. (Industry Advisor A, p. 9).

Further, pursuit of the bachelor's degree was viewed as advantageous to employees because it opens doors to higher pay scale opportunities. Industry advisors explained that salary in the information technology field is driven by two primary factors – number of years of service and academic degree. As expressed by one Industry Advisor: "That's the long and short of it. If you've got a bachelor's degree, applied or otherwise, it's 4 years, and your salary is going to be higher than someone with a 2-year degree, no matter what it is" (Industry Advisor B, p. 7)

However, a major challenge for employers is where to find people with the proper skillset for this profession. One industry advisor described the differences that he perceived between the approach taken in OSUIT's BT degree program and traditional BS degree programs. The OSUIT program sets students up to seek careers in a different direction than other colleges and universities.

> The problem with a student right out of school, if you look at traditional 4-year programs, if you go to the [Oklahoma State University] Stillwater campus, for example, you've got a computer science program, and those guys are really looking primarily to be software developers. And they come out with some really deep skill sets, and they don't want to develop simple stuff. … They've been trained to do things that are very deep computer science concept stuff. The reality is it's a small percentage of the actual software development work out there…
>
> If you go to the Stillwater campus, I don't know of a program that creates professional degreed candidates who support infrastructure; the people that maintain desktops, maintain servers, install and maintain networks.
>
> Historically we've either taken people that had a completely different background and caused them to learn on the job that skill set, or we've taken people without degrees, and we've gotten them A-Plus certified or some rinky dink like, "Hey, pass this test, and we'll pretend like you know what you're doing, and throw you in desktop support." But there hasn't been a degree program to provide that professional support tier of information technology professionals. And I think that this program does that. Not that the program limits you to that, but I don't think there's a program on the Stillwater campus that provides people where you can hire somebody with a bachelor's degree to fill those roles with an education that's focused on filling those roles.

Although bachelor's degrees are now required for entry level positions, the majority of industry advisors and employers that we spoke with in this case did not perceive strong differences in how they considered candidates with a BT versus a BS versus a BA or BS degree when it came to entry-level hiring decisions. The general attitude was expressed as: "I see a bachelor's, and a bachelor's is a bachelor's, is a bachelor's" (Industry Advisor D, p. 10). In regards to hiring entry-level candidates, one Industry Advisor's comments seemed to represent the general group reaction. He shared that:

> It doesn't really matter, at least in the position I was in, whether they would have an applied or a regular B.S. degree. They're going to be hired for the same kinds of functions at least in the organization I was in. And that is some form of development. It doesn't really matter. What's important there is that they have the ability to work on a team, to interact with people, and that they be able to write code appropriate for somebody just starting. (Industry Advisor C, p. 6)

A second Industry Advisor echoed this sentiment, saying: "The applied versus traditional, when reviewing candidates, it's irrelevant to me… I would look at the completion of the degree and the content of the degree. I understand that" (Industry Advisor D, p. 6). For these employers, the name of the degree or the degree designation matters less than the course content that makes up the degree. Are students learning the topics and skills sets that they want their employees to know?

In regards to decisions on promotions, the type of bachelor's degree held by an individual appeared to hold even less weight than in initial hiring decisions. As expressed by one Industry Advisor:

> [Promotions are] more about the individual than about the degree, in my opinion…
>
> I have several examples on my team of programmers that went through an MIS [Management Information Systems] program rather than a computer science program, and I'd put him up against anyone that's coming out of a computer science program. … I just promoted [one MIS graduate] to manager, and he is excellent with people whereas traditionally computer science folks and probably even applied baccalaureate types are more introverted. This guy is phenomenal both at the keyboard and with people. (Industry Advisor C, p. 11)

A second Industry Advisor expanded on the idea that it is about the individual, stressing the personality characteristics that go beyond technical skill and figure into promotion decisions. She shared that:

> Advancement is related to the personality as opposed to the skill set. It's more about the intangibles than it is the tangibles. We have a saying at [our company]. "You hire people for what they know; you fire people for who they are." …
>
> When we look for a candidate, we're looking for a candidate that not only has the tangible skills – if it's development, they know the right languages, they've done the analysis work, all of those things. But it's also those intangible skills, the softer things. Do they play well with others at work? Do they bring drama to the workplace everyday, or do they just come in and get their job done? So I think that advancement – it's the personality type. … They just have that drive and that personality. (Industry Advisor E, p. 11)

Finally, another Industry Advisor agreed that promotion decisions are about the "softer skills… the person's aptitude… how do they build relationships with their coworkers, with their customers?" He went even further to express that this skill set was not within the scope of academic programs – "And, there's not a degree program I know of that teaches that" (Industry Advisor D, p. 11).

Looking toward the future needs of industry, this group of industry advisors shared that one of the greatest gaps that they see is that "foundational education for professionals needs to be a much more generalist approach than it's been historically, and they need to work more on thinking systemically" (Industry Advisor D, p. 14). An example of the need for systems thinking was given from the field of security, with one Industry Advisory jokingly saying that "From a security perspective,… my first thought when you said that is we need more people to think like criminals!" (Industry Advisor C, p. 16). He went on to explain:

> The world is never perfect, and so, you have to be able to adapt and think systemically and take something from the position of: "I'm not creating something that's going to work; I've got something that doesn't work, and I need to fix it." …
>
> Then, there's the other side of thinking, okay, I have this thing. How can I screw this up? Because either somebody is going to intentionally do it, so how do I prevent that? Or, somebody is going to inadvertently do it, so how do I prevent that? So that critical thinking from kind of that contrary perspective.

Instructional Pedagogy.

Applied/hands-on learning. Employers who were a part of the BT in IT degree program's industry advisory committee noted that one of the strengths of the program is that students are taught in a hands-on approach, learning contextually not only the procedures of what their employment would entail, but the reasons behind it, providing both a theoretical and a practical learning setting. During the site visit to

OSUIT, researchers were able to see the server racks, computer labs, and other equipment that supported the BT in IT degree by providing hands-on training. One program administrator noted that much of the equipment was supplied by area employers, so the equipment itself came from real-world applications, suggesting that learning on such equipment would provide applicability to students.

Students also recognize the presence of hands-on education for the BT in IT degree program, even compared to other, more traditional programs. According to one student who had experience with engineering courses prior to entering the BT in IT degree program, noted:

> There's a lot of similarities, but…this is a lot more hands-on here, for sure. I think that helps my learning as far as picking subject areas up quicker, getting that hands-on training versus doing a lot of on-paper, pen-and-paper, and theory-type stuff. [This program] really actually puts it all to the front. (Students, p. 2)

Other students recognized that it was the hands-on emphasis of the training that made it more appealing to them than other institutions and programs.

Online and web-based instruction. The move to embrace online instruction in the BT in IT degree program at OSUIT "has been an evolution" (SN2, p. 20). One program administrator reflected that, as early as 2002, they knew that "this is obviously something we're going to have to get into" (SN2, p. 20), but the first challenge for OSUIT was where to begin. They wanted to balance the strengths of online education (e.g., broadening the geographic reach of their programs, delivering material to students in new formats, meeting student calls for opportunities for online learning) against the potential challenges (e.g., recognizing places where students would struggle, making sure students do not fall through the cracks, making sure students still get hands-on experience).

One program administrator described the growth in online offerings in OSUIT's BT in IT degree program like a ripple effect moving outward from the main campus in Okmulgee. He drew a map of Oklahoma, making a mark to indicate the location of Okmulgee and OSUIT (see Figure 3). He then drew concentric circles around that mark to demonstrate how OSUIT has strategically and thoughtfully been extending its geographic reach, saying:

> What happened is when we started the program, you had to come to Okmulgee 7:30 to 4:30… Then, we started offering some things where it made it viable for people in kind of the Tulsa metropolitan area. And today, it's possible, if you want to drive from Fayetteville, Arkansas, to come, it's about an hour and 45 minutes from Tulsa. You could drive that far if you really wanted to do it, if you're really motivated. (SN2, p. 21)

He explained that they have been doing this in a measured fashion, not rushing so as to ensure that quality is maintained with each expansion of their reach.

In the beginning, the faculty slowly tested the waters with a few courses – "someone said, well, how about we try database online? Okay, great. And, just overtime we've added it" (SN2, p. 21). One program administrator stresses that they have worked to "become a lot more strategic" over the years, learning from their experiences: "we know the students in this part are going to have a tough time, some of them, in getting our program, but they still want it. So what are we going to do for them?" (SN2, p. 21). Today, the OSUIT BT in IT degree program offers a "blended" approach to coursework, with part of their courses offered online, and others offered face-to-face. Program administrators report that this approach "seems to work. You're not giving everything up" either way (SN2, p. 21).

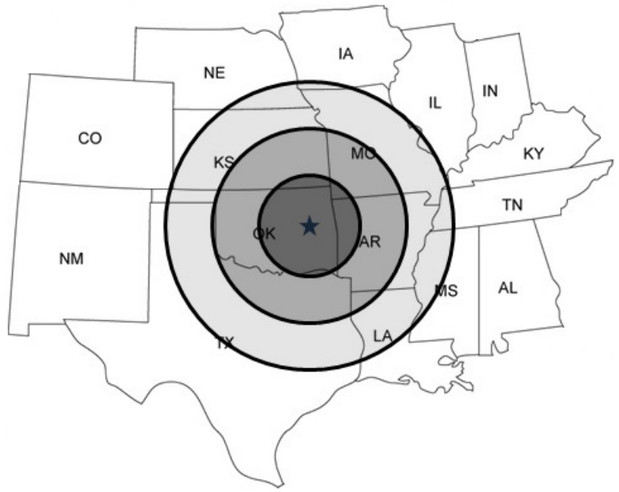

Figure 3. Visual depiction of planned growth in online offerings in OSUIT's BT in IT degree program over time.

A program administrator for OSUIT's BT in IT degree program commented that the change in the student population – that in which average student age rose, student course load dropped, and those living on-campus dropped – had some part in influencing the development of "alternate delivery coursework," which includes "online, hybrid, blended evening, weekend, that sort of thing…for the 2010-2011 school year, it was about 43% of what we offer is offered in [alternate delivery]" (SN2, p. 15). However, this growth is not expected to encapsulate the full range of courses offered in the BT in IT degree program. According to one program administrator, "a lot of our core coursework…like hardware systems and network systems…I don't know if we'll ever offer those fully online" (SN2, p. 20).

There seemed to be an emphasis on the value of "blended" courses at OSUIT, particularly for the BT in IT degree program. It was mentioned by many stakeholders – students, faculty, and staff – as one important means for delivery of courses. In the blended model, students attend part of a class in an online format, but are also required part of the time to be in a classroom. According to students interviewed, the blended model provides students some flexibility if they live a great distance away or cannot conveniently make it on-campus often, but also provides them the ability to learn hands-on the content that is most important to learn on-campus. For one student, a blended approach provided a course that introduced him to online education without requiring him to attempt his first online course in a full-time way. According to this student:

> I actually had a class that was a blended class. We met two days out of the week, in class, and then, on Friday, we had our classroom online. It really worked out well that way, and then, that's what actually transitioned me. I hadn't taken any online [courses] before that, and that's what transitioned me over to actually trying online [courses]. (Students, p. 11)

Program administrators added that they would be willing to make more courses fully online if they can do it "without diminishing the [quality of the] operating systems" (SN2, p. 21). New developments like virtual machines or virtual laboratories are providing students real ways of accessing server systems without having to be in a classroom or even on-campus in a computer lab.

One program administrator talked about the blended approach and how administrators and faculty are looking at online instruction in this way:

> The next step is, how do we figure out how to do the hands-on portion that we're not prepared to give up in a residential way? …
>
> [We could require] them to come to campus for three days in a semester. You do all of your hands-on, intensive stuff over those three days. Boom! You're done. That's going to open this circle up like that [pointing to the map referenced above, and reproduced in Figure 1]. That's kind of the evolution of the program and how we've been trying to approach what we're doing. (SN2, p. 21)

Program administrators and faculty recognized that there was a growth and an expectation that more courses would be online, but they indicated they have a hard time seeing a way to maintain quality without the hands-on components of in-class experiences. Further, they are unwilling to sacrifice quality for the sake of convenience that the online environment offers.

As of Spring 2012, the core courses for the IT degree were offered in both online and in-class formats, so that students could "choose which way they want" to learn (Faculty focus group, p. 8). Network systems and hardware courses were offered only in in-class formats, while security commerce and a handful of elective courses were offered in only online formats.

Internship. Students participate in either a 12-credit hour (ITD 4812) or 6-credit hour (ITD 4806) internship as a part of their upper-level course work in the BT in IT degree program. The "vast majority" of internships are paid. Students are "discouraged from taking unpaid internships" unless a student clearly articulates, "I want to go to this organization. I think the bottom line will benefit me in such a way that I'm okay with not being paid" (SN2, p. 24). OSUIT's philosophy behind the strong preference for paid internships is that these students have "worked really hard… gained skills and knowledge," as well as have an AAS degree and "may have a certificate or two" before beginning the internship. Employers should pay these students, as they would "pay someone with those skills and credentials and experience" (SN2, p. 24). In many cases, the OSUIT faculty find that the employers that they work with are agreeable to this viewpoint and practice.

Supports to help students achieve positive outcomes.

Tutoring. Tutoring is provided to students both inside and outside the IT department. Faculty encourage students to seek assistance from tutors as needed.

Sharing What Works: Evidence of Effectiveness and Success

Evidence offered as demonstration of success.

Post-graduation employment. One program administrator reflected that, "industry is certainly more aware of us because we have baccalaureate programs" (SN2, p. 21). Graduates from the IT programs are reported to find positions "just all over the place… in a given semester, you may have students, a third of them go to Fortune 500 companies; a third go to small to medium-sized organizations in rural Oklahoma; a couple of them go to start-up type organizations" (SN2, p. 23). However, faculty observe that the majority of their students are interested in seeking local positions – "students from Oklahoma like to go back to where they're from" (SN2, p. 23). Industry Advisors for the BT program echoed this observation, saying: "They like where they live; they want to stay where they live, to a great extent, and work for a business in the community" (Industry Advisor B, p. 5). A few students will leave the state, but they are in the minority and typically doing so "because they want to work for a specific organization, and that's the only place they can do it. An example of that, we've had students go to work for the National Security Agency" (SN2, p. 23).

Yet, in general, program administrators state that "all of the students, if they want a position, they've got a position leaving. … That's increasingly so as the economy has gotten better" (SN2, p. 23). Further, they reflect that "the secret to our placement" is the internships that is "almost a required component" of their curriculum (SN2, p. 23). OSUIT faculty report that, "in most of our students' cases," internships lead to offers for full-time jobs. As such, "placement isn't really that major of an issue for us" (SN2, p. 24).

Feedback from employers. Industry advisors spoke of the interns that they had hired from OSUIT's BT in IT degree program, saying that they have "been able to progress fairly rapidly" on the job "because of that hands-on experience that they had" in the classroom (Industry Advisor E, p. 5). These employers had the sense that OSUIT students' past experience in the lab translated into a willingness to actively engage in learning new hands-on skills. As one Industry Advisor reflected:

> When I said, this is the area you're working in now, but when you have time, you might want to study this language. "This might help you." They were able to pick it up and actually try it. They weren't afraid to get in and try to code. (Industry Advisor E, p. 5).

Descriptions of evaluation efforts.

Program review. One program administrator responsible for the BT in IT degree program at OSUIT noted that ABET program accreditation necessitated program evaluation and assessment efforts, noting "we have a pretty robust outcome assessment plan." Core courses at the associate degree-level are examined with a series of "core assessments" that are "consistent across all the courses [and] across the years by and large" (SN2, p. 24).

The next level of assessment occurs prior to students' internship semester during the Employment Orientation course (ITD 3201). During this course, students complete a number of proficiency exams, including: Work Keys, Reading for Information, Locating Information, and Applied Math, as well as a proficiency exam related to the area of concentration that they selected to go into. Students who do not meet "required test scores" on these exams have the opportunity to repeat the exams. However, they must engage in personalized advising with a faculty member first – "they have to get together with a faculty member who graded that assessment and work on 'We noticed that you weren't as strong in this particular area. Here are some recommendations that we have for you between now and the next assessment.'" (SN2, p. 25). One program administrator reported that "it is rarely even an issue that students don't do well" on the exams given during the Employment Orientation course – "usually one or two per semester" (SN2, p. 26). As such, these exams are primarily used for: "learning about the program and how we're doing, and are we preparing? If everyone does poorly in this one particular area, we know that that's something we need to address somewhere else" (SN2, p. 26).

The next level of assessment occurs when students engage in their internship experiences. There is an evaluation process in place that allows "the internship mentor [to] evaluate the students as well as us [the degree program]" (SN2, p. 26).

Finally, in their last semester, students engage in a capstone project in which they complete an applied research and development project. This provides additional information that "also feeds into the assessment of outcomes" (SN2, p. 26).

Outside of the immediate IT curriculum, data is gathered from the arts and sciences group on campus who engage in a process of "core general assessments." These data are brought to the table, along with the IT-specific data. Each year, the IT faculty gather for a full day to engage in discussions about curriculum decisions based on the data that have been gathered. As described by one IT program administrator:

> We sit down from first in the morning to the evening, and we literally go through every course. We look at issues relating to any coursework, relating to things that have come up in the assessments. We look at all of our different assessment pieces and where we are. We make decisions and document those. And then, a year from then, we take a look at what did we say we were going to do? Did it have the impact? (SN2, p. 27)

Sharing What Works: Replicability/Usefulness to Others

Developing AB degrees at primarily associate-degree granting institutions. As experienced in the reflections in this case study report, the development of a applied baccalaureate degree at a primarily associate-degree granting institution is a major undertaking that has implications for the students, faculty, and administrators, as well as the entire institution that houses them. Reflecting on the experience of embracing this change, IT program administrators and faculty had advice to share with other primarily associate degree-granting institutions who may be considering developing their own applied baccalaureate degrees. To begin, they advise developing applied associate degrees in areas that are known and recognized strengths for the institution. As expressed by one IT program administrator:

> I can't imagine a two-year institution rolling out baccalaureate degrees in an area in which it wasn't historically very strong and didn't have very robust resources to include relationships with business and industry. I just don't see that being able to go. (Faculty focus group, p. 16)

Strong historical background in the field, as well as the ability to draw upon the support of set of employers and industry advisors, was seen as providing a firm foundation from which to build a new degree program.

On top of this firm foundation, the IT program administrator advised that key players within the institution need to be willing to make a deep commitment to pursuing the goal of the applied baccalaureate degree. He shares that:

> I think the other part is the institution and everyone affiliated to the program has to make a commitment that we are involved with a baccalaureate-level program. Our identity is no longer as a 2-year program; it is a 4-year program, and we have to take on the rights and responsibilities of all those things associated with that….
>
> You are taking on a lot by bringing that responsibility on yourself. It's something we talked about a lot. Five of us were here when we did that, and it was a lot of discussion about this is something we should do. Collectively we decided it was, but still, again, everyone participates in the decision, but everyone participates in all the work that comes from it. (Faculty focus group, p. 16)

Commitment to the process means a willingness to embrace change, not only in program offerings. But, change must also be embraced in personal and program identity as it is defined first by key external stakeholders, and later by more subtle internal cultural shifts.

Selecting an advisory committee. Another administrator, recognizing the importance of having a highly involved group of employers advising the development of programs, notes "it's a gamble when you're preparing specifically for an industry," primarily because it may be limiting to students, and specific employers may not always be around. The administrator encourages other institutions considering similar programs to "select [your] corporate partners very carefully, to look at their track record, their longevity as an organization, their creativity in staying ahead of their competition" (BP, p. 8).

Reflections on Higher Education from an Institutional Administrator

One institutional administrator reflected on institutional missions and their responses to external influences and stakeholders. Although I am not sure where to put these ideas in our standard case study report structure, they are compelling for our writing, and I want to make sure we have them recorded for future use.

He expressed that the U.S. recession of 2008 lead to permanent changes in the U.S. job market that higher education institutions need to respond to if they are to serve students well. Community colleges, based on their historical connection to industry and workforce development, are perhaps better positioned than four-year colleges and universities to respond to the new demands. In his own words:

> The United States changed in 2008, and a lot of 4-year colleges never got the memo. The job market has changed. How you prepare young people for the job market is totally different. I mean, I was a counselor years ago, and I've counseled countless students with the advice, "Just get your bachelor's degree. As long as you have your bachelor's degree, somebody is going to hire you, and they're going to train you to do the specifics on the job. It doesn't matter what it's in, just get your bachelor's degree." Well, the rules have changed. (BP, p. 6)

The reality for many students is that the completion of a college degree no longer offers the assurance of being able to find work. This institutional administrator expressed concern that the gap between college and work was exaggerated by situation that higher education professionals in four-year colleges and universities were not communicating with employers about their needs, and therefore, students were leaving college without developing the proper skills for employment.

> The problem at most 4-year colleges and universities is they're listening to themselves. They're in the ivory tower, and their curriculum is being reviewed by other academicians. They're talking to themselves about what's in the best interest of the students, and they're leaving the employers out of the loop. (BP, p. 6)

This institutional administrator suggested that the focus for curriculum should change, placing employers at the center. Suggestions were offered that employers should be at the heart of the conversation when curricula are developed.

> The employers should be the focus. The employers should be our primary customer, not our faculty, not our tenured faculty. And I hate to say this, not necessarily our students either. It's about the jobs; it's about the employers. That's what's going to benefit out students in the long run (BP, p. 6) …
>
> We want to make sure that we are being relevant to industry. The only way that we can remain relevant is to listen to the needs of us changing. Because they're looking around the corners; they're helping us figure out where the jobs are going and where the skill sets are needed….
>
> In the United States, the major problem affecting our workforce is not a shortage of jobs, as many people believe; it's a shortage of skills for the jobs that are available out there. All that we're doing simply is just listening to the people with the jobs, and they're telling us what skills they need, and we're trying to prepare students with those skills. (BP, p. 10)

In addition to listening to employers needs in order to shape curriculum, this institutional administrator stressed that the employers themselves provide excellent resources as instructors because of the industry experience that they can bring into the classroom.

> It's about who you hire to teach. At OSUIT, a real part of the success here has been the hiring of industry-trained faculty members. And if you get someone here with 20 years of experience that has never taught before, I'll take that person all day long, everyday, to be an instructor here, because I can teach them how to teach. And we can do academic excellence, and we can teach them pedagogy; we can teach them classroom discipline. We can do everything that we need to, to teach them how to teach. But if you get that person on board, that person understands the industry. They understand expectations of the employer. They understand what the student is going to encounter once they leave the institution. (BP, p. 6)

Involving employers in decisions about curriculum development and engaging employers as instructors are strategies engaged by many community colleges. Yet, the institutional administrator that we spoke to took the employment focus of OSUIT one step further. Even in today's higher education environment that is highly focused on college completion, he stressed that their campus embraces a different primary focus – job attainment. He shared that:

> OSUIT, as an institution, is more focused on job attainment than it is on degree attainment. I know that sounds horrible, but OSUIT faculty are looking beyond the diploma. The diploma is fine. The diploma is necessary. But it's not the end all. The end game should be the job. (BP, p. 6-7)

He went on to express the idea that a primary focus on graduation rates offered a very limited perspective on the responsibility of the institution and the outcomes of higher education, saying:

> Unfortunately, most 4-year colleges see that the end game is the graduation rate. As long as we have a good graduate rate, and we graduate a high percentage of the students here at the institution, you shake their hand and hand them a diploma, we're done; it's somebody else's problem. That's not the way that we can look at it in the future. (BP, p. 7)

RSC's Associate of Applied Science (AAS) in Networking and Cyber Security

Rose State College (RSC) is an associate degree-granting institution located in Midwest City, Oklahoma, an eastern suburb of Oklahoma City. According to RSC's website (http://www.rose.edu/about-rose/, Retrieved July 1, 2013), the institution first opened its doors in 1970, as Mid-Del Junior College, and "was renamed Oscar Rose Junior College in memory of the Midwest City-Del City Superintendent of Schools." In 1983, the institution was officially renamed to RSC, with twenty-five buildings on approximately 120 acres in the campus.

RSC is academically organized into five divisions: Business and Information Technology, Engineering and Science, Health Sciences, Humanities, and Social Sciences. The institution offers almost 60 degree and skilled-occupational programs, many of which aim to prepare students to complete a bachelor's degree. Classes at RSC are designed to be flexible, including day, evening, and online courses in two, four, eight and 16-week terms.

RSC was developed under the guidelines provided by the Oklahoma State Regents for Higher Education, which aims to assure the transferability of credits from RSC to bachelor's degree-granting institutions within the state of Oklahoma. RSC is also accredited by the HLC.

The stated vision of RSC is to be: "The community college of choice: supporting, serving, and advancing the common good." The institutional mission states that: "As a public, open admissions, associate degree

granting institution, RSC provides higher education preparation for lifelong learning through programs and services designed to serve a diverse community."

RSC also has a set of four core values that guide institutional philosophy, operation, and planning:

- **Learning**: The institution is a learning-centered environment where students will be afforded ample opportunity to succeed in meeting their educational goals as partners in the pedagogical process.
- **Excellence**: The institution makes a commitment to internal and external constituents to make each program and service one of excellence by establishing high standards that sustain and promote higher education in an innovative, learning-centered environment.
- **Integrity**: The institution maintains fair, honest, accurate, and consistent policies and procedures monitored by measures of institutional effectiveness to ensure credible actions are taken to further a diverse learning-centered environment of individuality and collegiality.
- **Service:** Through teamwork on campus and in partnership with the communities served, the institution strives to improve the quality of life in an urban setting by offering programs and services based on the needs of students and citizens and designed for measurably improving the aesthetic, physical, economic, social, political, and intellectual environment. (http://www.rose.edu/about-rose , Retrieved July 1, 2013)

RSC Current Students

According to the NCES' IPEDS College Navigator, in Fall 2011, a total of 8,150 students were enrolled in undergraduate degree programs at RSC (1,139 of those as transfer-in undergraduate students). Of those students, 61% attend full-time and 39% attend part-time. Approximately 39% of undergraduate students are male, and 61% are female. A total of 59% of the undergraduate student body self-identified as White / Caucasian, 17% as Black or African American, 5% as Hispanic/Latino, 6% as American Indian or Alaska Native, 2% as Asian, and 6% as two or more races. "Race ethnicity unknown" was reported for 4% of undergraduate students. Nearly all students are in-state residents. In regards to students' age, 51% were reported as 24 and under, and 49% were reported as 25 and older.

Of first-time, full-time students who began their studies in Fall 2008, 12% graduated and 22% transferred-out within 150% of the typical completion time for their degree program. The within 150% of "normal time" graduation rates were comparable for females (12%) and males (11%). The within 150% of "normal time" graduation rates differed by race/ethnicity, and were as follows: American Indian or Alaska Native: 7%; Asian: 36%, Black/African American: 5%, Hispanic/Latino: 16%; White: 25%; and Race/ethnicity unknown: 7%.

The IPEDS data from Fall 2011 reports the student-to-faculty ratio of RSC is 22:1. The institution had 134 employed full-time faculty and 249 part-time faculty, all primarily serving in instructional roles.

According to the RSC, "Notable Facts FY '12" website (http://www.rose.edu/about-rose , Retrieved July 1, 2013), in Fall 2012, a total of 11,897 students were enrolled at RSC (41.7% of those are minority population). Of those students, 58.6% are female, and 41.4% are male. The median age of students is 24 and the mean age is 27. The average class size is 19.

The AAS in Networking and Cyber Security Degree Program

According to one program administrator, RSC has had a long history of an AAS degree in Networking. He shared that the Networking degree program "existed long before I was even here [and] I've been here 14 years" (ZDS, p. 2). However, the faculty that we met with described that program as "kind of weak" (ZDS, p. 2). The 2003 academic year was marked as a turning point for the degree program at RSC. In that year, the University of Tulsa received a grant from NSF-ATE to develop programming in CyberSecurity. The University of Tulsa faculty contacted RSC, saying "we want you to have a CyberSecurity option as well" (ZDS, p. 2). Placing the CyberSecurity as a degree program concentration "option underneath networking, which was already there" (ZDS, p. 2) provided a means to quickly move forward with the project (rather than the alternatives of submitting a new degree program request to the Oklahoma Regents for Higher Education). This allowed the CyberSecurity degree program to be available to students in 2003.

According to one program administrator at RSC, OSUIT and RSC were both developing their CyberSecurity/Information Assurance and Forensics programs at around the same time, noting that "there was a *lot* of curriculum development that had to go along with that" (ZDS, p. 3). However, noting how upper level administrators and others were pushing the program to be developed quickly, program administrators and faculty reflected that "when they're pushing you to hurry and get it going…you tweak it along the way" (ZDS, p. 3).

Program learning goals and objectives. According to RSC's catalog, the program goals of the Networking/CyberSecurity degree program include:

1. preparing students for entry-level employment in positions requiring networking skills;
2. providing course work for students seeking career advancement; and,
3. offering a customized educational program to allow students to specialize in networking or cybersecurity.

Specific objectives of the CyberSecurity Option of the Networking/CyberSecurity degree program include providing students with:

- A basic foundation of introductory networking and operating skills as a basis to learn and apply more advanced skills;
- An understanding of the five categories of infrastructure network management and the application of each;
- An understanding of upcoming technologies such as wireless, biometrics, remote access, and forensics investigations; and,
- Customizing the student's educational program by offering a choice of specialized skills in networking or cyber security. (http://www.rose.edu/Websites/rose2010/Images/Academics/Business%20and%20IT/NETCYBER_CO_0191-02.pdf)

The program outcomes, as part of the catalog, are listed as students being able to pass the required industry certifications.

Curriculum design. The course sequencing for the CyberSecurity option of the Networking AAS degree consists of four groups of courses:

- General education requirements, consisting of seven courses in a variety of subjects including English composition, U.S. history, government, college algebra, and personal finance, for a total of 20 credit hours
- Program requirements, consisting of 8 computer and information technology courses and one discrete math course, for a total of 27 credit hours
- CyberSecurity option courses, consisting of 5 prescribed courses in computer and information technology related to CyberSecurity, for a total of 15 credit hours
- Support and related requirements, consisting of 6 additional credit hours of computer and information technology coursework

At a minimum, students complete 68 credit hours in the AAS in Networking and CyberSecurity degree program.

The curriculum was developed via collaborations both at RSC and University of Tulsa, and is also influenced by industry experiences of the faculty at RSC. The program faculty describe their CyberSecurity curriculum as "one of the tougher ones around," saying that "the students really complain about how tough it is… [but] we don't apologize for being the toughest, because our students are the ones that are sought out because they [employers] know it's tough here" (ZDS, p. 5). Students are required to earn a "B" or higher in the five core CyberSecurity courses. Students who receive a grade less than a "B" are required to retake the course to receive credit toward the major. The program faculty explain this strict grade restriction as follows:

> Let's pretend you're a doctor. I would really hope that you got a "B" or better in your – actually, I would hope that you would've gotten an "A" if you're doing my treatment. I feel the same way in cyber security, because cyber terrorism is so predominant right now with anything: our water systems, the police department, everything is computerized. You have got to understand those systems, and if you don't, you have no business in this program. I don't want to sign off saying, yes, they did all of the requirements, but they were mediocre. No. You need to be the best of the best if you're going out there to protect my system. That's the way that we look at it here at Rose State. (ZDS, p. 6)

Math requirements. As part of the required general education coursework, students must have passed college-level algebra and an economics course described as "personal finance." No other mathematics requirements are listed for the AAS degree program.

Information Security Certificate programs. Along the way toward receiving the AAS degree in CyberSecurity, students can receive certificates that align with the Committee on National Security Systems Instruction (CNSSI) standards. The CNSS provides federally-recognized technical criteria for specific national security systems issues in six areas, including:

- 4011 - Information Systems Security Professionals
- 4012 - Senior Systems Managers
- 4013 - System Administrators
- 4014 - Information Systems Security Officers
- 4015 - Systems Certifiers
- 4016 - Risk Analysts
  (http://www.cnss.gov/instructions.html, retrieved January 15, 2013)

RSC is one of a very few higher education institutions and, as shared by one program administrator, the "only two-year college in the nation that can issue all six of those CNSS certifications at the federal level" (ZDS, p. 1). There is considerable overlap in courses among the certificate options, so that students may work toward multiple certificates simultaneously. For example, as shown in Table 27, the 4012 certificate extends the 4011 certificate with the addition of a single course in Enterprise Security Management, providing "the additional body of knowledge required by Designated Approving Authorities to accredit, extend and operate enterprise information systems in a secure mode" (Information Security Certificate Program Brochure).

The emphasis on the completion of certificates along the path to AAS degree completion has wavered over time at RSC. According to program administrators, at one time, the program involved students receiving certificates en route to the AAS degree, but that the practice stopped, as "it wasn't going as well as we'd have liked" (ZDS, p. 1). However, this same program administrator also commented that certificates were returning because "the [Oklahoma

Table 27. Comparison of Course Requirements for Two Information Security Certificate Programs

Required Course	NSTISSI 4011: Information System Security	CNSSI 4012: Designated Approving Authority
CIT 2563 Computer Security	X	X
CIT 2513 Security Electronic Commerce	X	X
CIT 2403 Advanced Networking	X	X
CIT 2543 Info Security Assurance	X	X
CIT 2523 Enterprise Security Management		X
IA Elective	X	X
IA Elective	X	X

State] Regents have changed the rules" (ZDS, p. 1) with a large push for increasing college completion. He reflected that "in a two-year institution, it's really hard to get completion rates" (ZDS, p. 1). Yet, the Oklahoma State Regents had "decided now that if we can get someone to complete a [certificate], then that's going to count as a completion. So now we're bringing that back" (ZDS, p. 1). Added another program administrator, "when they complete those five or six core designated courses…they're able to get a certificate. So it's not in lieu of the degree, it's building blocks to get to the degree" (ZDS, p. 1).

The hope for students is that "they walk out of [RSC] not only with that degree; they've got all those certifications, all those acronyms after their name, and people want that" (ZDS, p. 11). Employers are looking for individuals who have passed certification exams as an indicator of skills that have been obtained. And, this is viewed as a way to give students an edge in the job market.

Student Enrollment and Demographics

Students come to the AAS degree program in Networking and CyberSecurity from a wide variety of backgrounds. The program does recruit at the high school level, and many of their day-time students are drawn from this population. Yet, their evening students tend to be drawn from a more non-traditional population. Students come from Tinker Airforce Base, General Motors, AT&T, Spring, FAA, Boeing, and DISA, among other local employers. The program administrators singled out "Tinker and the FAA[as] being major employers" who send students to their program (ZDS, p. 6).

Additionally, students come to the CyberSecurity degree program with many goals in mind. Some come for the associate degree. Tinker Airforce Base sends students because "they want those airmen to get their baccalaureate degree. They know about our relationship with OSU, and that's been probably the best seller that we've got, is that we've got that relationship, and they can stay here" (ZDS, p. 7). Other students come to RSC already having a master's degree, yet they want to "come back in to refresh their skills, or they just want those certifications" (ZDS, p. 6).

Articulation and Transfer

RSC and OSUIT. Reflecting on building the pathway from RSC's AAS in Networking and CyberSecurity degree program to OSUIT BT in Information Technology degree program, program administrators focused on the relationships that brought the programs together and facilitated the process. As one RSC program administrator explained:

> We've known S___ [OSUIT program administrator] for a long, long time, and he approached us and said, "Well, why don't we have an articulation agreement?" I'm like, "I don't know. Why don't we?" So his people and our people got together, looked at our curriculum, came up with a plan.
>
> Dr. Cook was the president at the time, and Dr. Cook was like, "Let's do this." And the presidents got together, the Regents all got together, and it went extremely fast, in my opinion. We were able to implement that just in a matter of months. (ZDS, p. 8)

The biggest challenge encountered when creating the articulation agreement was the similarities between the classes at RSC and OSUIT. As described by on program administrator at RSC:

> Oklahoma regents, they get kind of picky. So if we had a SSA [Secure System Administration] class and [OSUIT's class] was called SSA, they had a problem with them transferring it over… because they won't let you overlap… Students have to take a different course that's beneficial for them. (ZDS, p. 8)

As a result, the faculty at OSUIT had to develop new classes at the 3000 and 4000 level. This way, RSC students could transfer their AAS degree courses as electives in lower-division requirements, and they would still have opportunities to take upper-level courses in new areas.

Another option shared by RSC faculty for differentiating between lower-division and upper-division coursework is to add projects and research to a lower-division course. As described by one faculty member:

> It gets more rigorous. [Students] have to present. They have to do three or four more projects than the associate's level. They have to actually get in there and do some hands-on stuff that the other ones may not be required. They have to write policy, which they hate. So there's a lot more into it. It's just like when you go to a university and you've got undergrads and graduates at the same level, but yet you're doing different work. It's really kind of the same kind of concept. (ZDS, p. 9)

While this strategy of a more rigorous assignment schedule seems used and acceptable, it is not the preferred route for many key stakeholders. One faculty member reflected that "kids scream about" the extra workload, and that "ABET and the State Regents preferred the approach when students take another course to satisfy the credits" as opposed to repeating a similar course with a heavier workload (ZDS, p. 9).

In another interesting feature of the RSC – OSUIT partnership, most of the upper-division courses for the BT degree are offered on the RSC campus in Oklahoma City, although the degree is conferred by OSUIT. In this way, students who graduated from RSCs' AAS degree program "don't have to physically go to Okmulgee, maybe once or twice a year, to finish up their bachelor's" (ZDS, p. 7). Instead, they can keep the same commute and education environment that they had become accustomed to during their associate degree program. This creates an opportunity for students to access the BT in Information Technology program in their own geographic location. It also provides an interesting opportunity for RSC to provide access to a BT program on their campus, even though RSC does not have the authority to confer BT degrees. As described by on program administrator, the awarding of community college baccalaureate degrees is a "very political" topic in the State of Oklahoma:

> In the State of Oklahoma, there's a moratorium on right now… Rose State had applied for a bachelor in technology. But some of the major universities in the area, not OSU, but some of the others, they said, "Well, no, that's not the mission." So right now, nobody other than a four-year school or affiliate like [OSUIT] can offer a bachelor's in the State of Oklahoma. (ZDS, p. 12)

Student Reflections on Articulation and Transfer. Considering the transfer of their AAS degrees to a bachelor's degree program, students identified two key aspects of the relationship between RSC and the BT in IT degree program at OSUIT that had caught their attention – the uniqueness of the bachelor's degree program offerings and the smooth transition of credits between institutions.

For example, one student noted that he had attended a community college prior to attending RSC and had some classes completed in network security. After taking some courses, he "wanted to move forward and pursue a higher education, and see if I could get my bachelor's degree" (Student focus group, p. 2). He investigated potential programs in Oklahoma and nearby states that would accept transfer of the courses he had already taken. He was only able to find one other program, in Las Vegas, but the program was being closed down. When he discovered OSUIT's degree, he realized it was "one of the few universities in the whole nation that actually teaches Computer Forensics and Information Security" (Student focus group, p. 2). Other degree program options in related fields were focused on computer science, which "totally different" course requirements. The close relationship between his associate degree curriculum and the bachelor's degree curriculum was viewed as a strong benefit of the OSUIT articulation agreement.

Students described a second key benefit of the relationship between RSC and OSUIT as being the ease in transferring information security coursework to OSUIT. One student shared that: "I realized I could transfer up to 80 to 85 percent of whatever [courses] I had done. So it was a very smooth transition right there, so I wouldn't be so much behind" (RSC, p. 2). This ease of transferring credits meant that students would be able to move right into their Junior year of coursework, leaving only two years of coursework to complete for their bachelor's degree. This is in comparison to other bachelor's degree opportunities that would not accept as many of their associate degree credits, increasing their time and expense to degree.

Faculty Roles and Positions

There are four faculty members that teach cybersecurity courses full time at RSC. One of these faculty members is the director of the program, so he is only allowed to teach four classes per semester. The

remainder of the full time faculty members are contracted to teach five classes as a full load, which is 15 credit hours, per semester. Yet, they are allowed to teach up to seven classes per semester (21 credit hours) for extra pay, and most often do.

The full Business and Information Technology Division has about 40 adjunct faculty. Approximately 6 to 8 of those faculty members teach computer and information technology which contribute to the cybersecurity curriculum (and sometimes overlap with the networking curriculum). One program administrator reflected that "adjuncts are very difficult to find, and they're being snatched up. We lost four of our adjuncts this past semester" (ZDS, p. 19). Another faculty member echoed this, saying: "it's really hard sometimes to find an expert that's in that field, that's willing to come and teach for you. It's very difficult" (ZDS, p. 19). The faculty at RSC have relied on their past contacts in industry to find adjunct faculty to teach courses, often calling favors with past colleagues. Ultimately, they feel that they have been very successful in hiring talented educators – "we've been real fortunate about getting excellent adjuncts in here because of our relationship with [Past Employer] and because of the people that we once upon a time did know" (ZDS, p. 19).

Future Directions

Thinking forward about areas that they would like the degree program to grow and expand, program faculty expressed interest in building courses on emerging technologies such as mobile device security, cloud computing, cloud security, and SCADA (supervisory control and data acquisition). The challenges to moving forward in these areas include developing the course materials, purchasing the equipment needed to teach the course (especially in the case of SCADA), and "finding experts in the field that are willing to come out from their six-figure jobs to adjunct for me for $1500… and I only want the best of the best teaching these kids" (ZDS, p. 18).

Sharing What Works: Program Quality

Adherence to recognized standards - mapped to industry certifications. By using a building-block or stackable credential approach to providing the degree program at RSC, program administrators and faculty are able to provide students with a foundation for pursuing industry credentials as they pursue their AAS degree. Pursuing industry certifications typically requires an extracurricular examination be taken to qualify, and those industry exams often have an extra fee associated with them that must be incurred by the student. As stated by one program administrator:

> We can't say "you come to our hardware class and you're going to get an A+ [certification]." We can't say that. I can't guarantee anything, but our courses are geared towards that curriculum, so if [students] want to go out and they want to get that certification, they absolutely can. (ZDS, p. 11).

While it is not required that students pursue these federally-recognized certifications, it is strongly recommended because they are viewed highly by employers and can help students during their job search. One program administrator noted that it is very possible for "the students walk out of here with all those federal certs" (ZDS, p. 11), if students chose to pursue that route.

Beyond mapping to the CNSS standards, RSC has engaged in the process to become designated as a National Center for Academic Excellence – 2 Year (CAE2Y) in Information Systems Security Education by the National Security Agency and the Department of Homeland Security. Becoming a CAE2Y institution requires looking beyond the curriculum, to engage in a "stringent process" (ZDS, p. 5) that examines how the entire College impacts program quality including partnerships with K-12 schools, articulation agreements with 4-year institutions, faculty credentials and education requirements, and so on. As a CAE2Y institution, RSC has become eligible for grant money to help "go out and promote [their] program," (ZDS, p. 5) further strengthening the reach of their networks with other higher education institutions.

Collaborations to Strengthen Quality and Effectiveness.

Partnerships with higher education institutions. The collaboration between RSC and OSUIT was recognized by program administrators and students alike as providing a valuable program on RSC's campus. In addition to the convenience it provides, some see it as allowing for a more effective program by reaching the populations that want that level of education the most. According to one RSC program administrator, "we show [prospective students] that we've got this seamless recruitment…they come here, they do the Rose State thing, they go to [OSUIT], and if they're good enough, then they can go on for their master's at Tulsa University. And we've had several actually do that" (ZDS, p. 14). Students recognize the opportunity that this collaboration provides them. According to one student, "I went to gain some certifications just to kind of advance myself. That wasn't enough…that kind of got my foot through the door. Community college was…a start" (Student focus group, p. 5).

Industry partnerships. Students also recognized RSC's involvement of employers as providing valuable support and validation to their pursuits of their degree programs. One student provided an anecdote regarding a seminar given by an employee of the Federal Bureau of Investigation (FBI). According to one student:

> We got a wealth of information from him that nowhere else you can get…this semester I have a psychology course, and before that I didn't know, why do I need to know psychology for computer security or forensics? But you have to know the psychology behind the person that you retrieved the data from. (Student focus group, p. 5)

In this case, having a professional from the field justified how there were things that were essential to learn in the classroom so that students could apply what they had learned in a professional setting. That was the type of connection that was enhanced through employer involvement.

K-12 and community outreach. One of the challenges that faculty expressed about the CyberSecurity program, and the field in general, is the low number of females participating. One program administrator expressed that: "when we first started this program, we had 20% women. I don't have that now. I might have 8. So this is a male-dominated field" (ZDS, p. 14). The key to changing this trend was seen as recruiting students early – "and it doesn't just start at the high schools. You really need to start at the middles schools" (ZDS, p. 14). The faculty members talked about the importance of showing students a female instructor and role model, demonstrating "some little tricks of the trade," and helping students see that "Wow! I can do that. That might be fun." (ZDS, p. 14).

As a part of early recruitment, RSC faculty get students involved in CyberPatriot competitions – "our first year, we actually sent two teams to the national finals" (ZDS, p. 13). They also talk about scholarship opportunities and the seamless articulation opportunities to the bachelor's degree and beyond.

Professional development and grant seeking. RSC program administrators noted that faculty involvement and professional development was critical to how they developed their curriculum in CyberSecurity. For one, they have a strict requirement that all faculty members who teach students in CyberSecurity have the same types of certifications that their students are pursuing. According to one program administrator, "the students will not have respect for you if they're working for those certifications [and] you don't have them…Even with our adjuncts, we make sure that they have

certification in that area too" (ZDS, p. 4) This was a point of pride among the program administrators interviewed, as in their commentary of the development of the degree and articulation with OSUIT, their comments about the incoming faculty also included discussions regarding their various certifications. Additionally, one program administrator commented that faculty receive ongoing training as certifications and standards change, noting "if you want to stay current and you want to be the best, you have to keep your skills up, and you have to offer that [new] training to your faculty…you just have to find the funding somehow, be creative" (ZDS, p. 20).

Further, faculty at RSC had taken up their own NSF-ATE grants to help support students through scholarships, as well as a grant as a partner with the University of Tulsa, which "helped fund a lot of our equipment and everything" (ZDS, p. 4). They also had just received a new NSF-ATE grant to help support new equipment specifically within the CyberSecurity program, based on their recognition as a Center for Academic Excellence.

Sharing What Works: Educational Significance

Individual and Societal Needs Addressed by the Program. Students in particular noted a number of ways in which RSC and OSUIT were accommodating to their individual needs. According to one student,

> As a working student, and having a family…it was kind of hard to look for a place that would accommodate my needs, my educational needs. So…we came across OSU and the first thing I was worried [about] is how I am going to do the travelling, how will that happen? [I was] working and all that. So, they explained the relationship they had with Rose State and [said] you can take the classes here, and I'll get credit. (Student focus group, p. 1)

In this student's case, his geographic distance from OSUIT and family responsibilities necessitated that he have an accommodation for his limited time available for studies. Even more so, the online component also benefited him and his peers' academic needs by providing a different forum and a new format for discussion. Other students noted the degree of specialization within the cybersecurity field associated with the AAS at RSC and BT at OSUIT were contributors toward their decision to attend RSC and transfer to OSUIT.

Instructional pedagogy.

Applied and hands-on learning. Much of the coursework offered in the AAS degree program in Networking and CyberSecurity is offered in a "hands-on" format – "it's more hands-on than theory" (ZDS, p. 5). One faculty member shared how she uses her business networks to give students a first-hand look at computer security issues in the real world, saying: "I get to walk the [students] through. I can take them to clients and show them exactly what it is that they're up against" (ZDS, p. 5). In another example of hands-on and experiential learning, two RSC CyberSecurity classes were brought together for a course exercise. A server class was tasked with the job of securing a server, while a penetration testing class was tasked with the job of attempting to penetrate that server. Exercises like this create simulation environments which "make sure that the students really know what they're doing before they leave" the educational environment (ZDS, p. 6).

The format for exams in CyberSecurity classes is describe as using an essay format to test students' comprehension of key concepts. As expressed by one faculty member:

> The majority of all those exams, we don't give the Scantron… Anybody can take a Scantron. No. It's all essay, and they have to explain to us, "What did you learn from this class? Do you understand that question?" (ZDS, p. 5)

An example was also given from another instructor who teaches encryption. In his course he will "encrypt the question where they have to un-encrypt the question in order to answer it" (ZDS, p. 5), thus students are demonstrating both the skill needed to decrypt the text and the deeper understanding when they respond to the question. With the bar for success set so high, the faculty members express great pride in their students' ability to rise to the challenges that are set for them. During our interviews, one faculty member expressed with enthusiasm that: "we're dealing with brilliant students" (ZDS, p. 5).

Supports to help students achieve positive outcomes.

Dedicated faculty. One component of RSC that several students identified as providing tremendous benefit to them was an involved faculty and staff. According to one student, "the instructors have a lot of knowledge and are very helpful. Online, all the instructors are very helpful also; they answer you right away. They help you through the problems if you don't understand something" (Student focus group, pp. 3-4).

Financial assistance. To aid in students' financial needs for attending the program at RSC, the college and program uses some of its grants to provide scholarships. There are specific scholarships available only to students in the AAS program in Networking and Cyber Security, which are competitive, but require students have completed prerequisite course work such as college algebra. Other community supports, such as a program entitled *Tulsa Achieves*, provide additional support for individuals in the general student body who do not have the ability to pay for college.

Tutoring services. Another benefit of grant support to RSC, according to program administrators, is that they are able to provide tutors to AAS degree students. According to one program administrator, "once a person is in the program, to help make sure they succeed, we have the tutors we pay…I wish more students would take advantage of it" (ZDS, p. 17).

Student clubs and organizations. RSC offers opportunities to get students involved outside of the classroom, despite the fact that they serve a "commuter student population." For example, they have a CyberSecurity Club that brings in guest speakers, such as cybersecurity professionals from the FBI.

Sharing What Works: Evidence of Effectiveness and Success

Evidence offered as a demonstration of success. In one case, program administrators at RSC noted that enrollment was evidence of the success of the program. When the program first started, curriculum developers had to determine a target number of students who would attend the program, for budgetary purposes, "and we said, 'oh, I don't know, let's shoot for 12 because that's a magic number.' No, we had 40 the first year, and now we are up to, the last headcount was 602. So it is a very, very popular program" (ZDS, p. 3).

Employment outcomes (anecdotal). Program administrators mentioned some of the major employers of their graduates in the area. For example, they shared that the "FAA actually is one of our more predominant employees. Most of our students end up at the FAA," (ZDS, p. 6) estimating that they currently had 15 to 20 interns there. DISA and Tinker Airforce Base were also listed as "major employers" in the local area. Graduates of the CyberSecurity degree programs at RSC were said to be "sought out" (ZDS, p. 5) by employers because of the reputation of the program's rigor and strong preparation of students.

Employment locations of graduates are known because, as one program administrator reflected: "most of the students in the CyberSecurity program here have been wonderful about staying up with us" (ZDS, p.

13). Students and faculty stay in touch through social media and social networking tools such as Google Plus. Faculty can "keep close tabs on the majority of [students]" because students "become close to their instructors" and find value in coming back to the faculty for "professional advice" (DZS, p. 13). Recalling findings from a recent survey of graduates, faculty shared that over 88% of respondents were employed in the IT field. Government is another large employer of AAS in Networking and Cyber Security degree program graduates.

Continued education (anecdotal). Faculty for the Networking and CyberSecurity program at RSC estimate that at least half of their graduates pursue a bachelor's degree. As expressed by one faculty member: "I know for a fact 50% of those are going on for the BT somewhere; it may not be at OSU. But they're going somewhere for a bachelor's degree" (ZDS, p. 13).

Students are motivated to pursue a bachelor's degree because employers are pushing for this level of degree attainment by: (a) demonstrating a preference in hiring decisions, (b) showing a difference in position offerings and pay scales, and (c) offering financial support for continued education. Evidence of these employer supports are found in comments made by a RSC program administrator, as follows:

> [Employers] would prefer that the student go ahead and finish their bachelor's. Of course they would. The student is not going to move up into a management position unless they have it.
>
> With the BT and the employers, there's always sort of a back pressure. If I take an AAS student who has a certification, and have that part of the degree, I can pay them less because they're a technician…
>
> I'll give you an example. This is the reason our students go ahead and pursue the program at OSU. They get the internship out at the FAA. They start out at $20,000 as an intern. … And then, once they get their BT and they go on full time and they sign a contract. They go up to $50,000 a year.
>
> DISA is the same way. Anyone who goes out there with the associates and they're working, they have a program where they'll actually pay you to go to school. They'll pay for your education. Why would you not? And then, once they get that BT, their salary almost doubles. So it's a huge incentive for those students to go right on ahead and get that BT. (ZDS, pp. 9, 12)

Descriptions of evaluation efforts. Program administrators at RSC noted that there were evaluations and assessments that were valuable to the AAS degree program. For one, "we have a college-wide assessment plan, and part of it would be to look at five different things; we rotate one every year. One area is with technology, and one area is with critical thinking [and so on]. And so, that's the large picture that the whole campus has to do" (ZDS, p. 16).

In addition, the requirements of working as a part of NSF-ATE and the CSEC consortium required "a lot of self-evaluation" (ZDS, p. 16). Part of the limitation of more in-depth examinations of students is related to the mission of the college. Because RSC is "an open to everybody school [and] we have to accept [all students]," (ZDS, p. 16) evaluation strategies such as exit examinations are not possible.

Sharing What Works: Replicability and Usefulness to Others

One message that program administrators shared with our site visit team is that, when developing a degree program, it is essential "to have champions of the program. There's no way that this can work without some key players. There's just no way it's going to work" (ZDS, p. 3). These program administrators had the sense that the success of their program was built on the passion and energy of a few individuals who were willing to build networks, advocate for the needs of the program and the students, push the program through the difficult times, and communicate the strengths of the program to key stakeholder audiences.

As one of the founding faculty members expressed:

> It has to be a passion. You have to be passionate about what you do. And we are here at Rose State. We're very passionate about what we do. I get excited about the students, when that ah-ha moment comes. That's the biggest thing. And what's great is you train them, get them to go on and finish, and they will come back, and they will adjunct for you. So that's very crucial. Keep it going. (ZDS, p. 20)

However, those enthusiastic faculty members cannot stand alone. They need the support of individuals within the leadership to stand up for the program and to pave the way politically. As described by one faculty member:

> I can't stress enough how important it is to have somebody that is a champion of this. Because if you don't have somebody that's behind that and behind your faculty, it's not going to work. [Our department chair] has been wonderful. [Our contact at OSUIT] has been wonderful. If we didn't have them on the sidelines, cheering us on, telling us you're doing – an at-a-girl every now and then is really, really special – it's not going to work.
>
> You have to motivate your faculty. That's the only way this is going to work. You have to motivate your faculty, because if you don't, it's going to fail. And we've seen a lot of our sister schools that have tried to do the same thing, but they're not quite as motivated. (ZDS, p. 20)

Tulsa Community College's Associate of Applied Science (AAS) in Information Technology

Tulsa Community College (TCC) was formed in 1970 in Tulsa, Oklahoma as Tulsa Junior College. Over its history, "TCC has become Oklahoma's largest, multi-campus community college serving 35,000 students in credit and continuing education programs annually" (http://www.tulsacc.edu/about-tcc/college-history, para. 1). TCC has four campuses (Metro, Northeast, Southeast, and West). In addition to its formal campuses, TCC offers course in other facilities, such as community outreach centers, concurrent enrollment courses with public high schools, offerings of classes in area prison systems, and a partnership with Tulsa Technology Center. At the time of the site visit, there was an anticipated opening of a new TCC campus in Owasso, Oklahoma. According to the TCC website (http://www.tulsacc.edu/owasso), this campus will start offering courses in Fall 2013. The TCC website states that they offer more than 200 associate degrees and certificates.

The campus visited by the OCCRL research team was the Northeast campus. According to one administrator at this campus, "this campus opened technically in [1977], and it was a trailer. This [area] was a pasture. In fact, one of the best stories is [that] our president…actually worked in horticulture, and so, he had to mow the grass and we would have to lock the gate at night here on campus" (EE, p. 7). TCC's mission statement states that:

> Tulsa Community College betters its community through the intellectual achievement, creative energy, and responsible citizenship of its students, faculty, and staff by their engagement in teaching, learning, and service opportunities that transform and enrich lives. Tulsa Community College commits to innovative, flexible, and affordable public higher education that responds to a dynamic global environment.

The institution sets priorities and seeks to achieve this mission based upon five core values, which include:

Student Success is the reason TCC exists. We strive for all students to be successful in their educations and we strive for the education to effectively prepare students for their lives. Learning is the focus because it is the essence of an institution of learning.

Excellence drives us. We strive to provide excellent education to our students, excellent resources to our community, and excellent administration and management for our employees.

Stewardship guides our daily decision-making. We investigate community needs and expectations and then respond by providing quality education that is responsive, convenient and affordable.

Innovation sparks our creativity and ensures that the hearts and minds of our students, faculty, staff and administration are actively engaged in acquiring learning, increasing our knowledge, and leading the community forward.

Diversity is our common bond. Sincere appreciation for and cultivation of differences enriches our lives, the community, and the education we offer. It is a source of our pride and integral to our success. (http://www.tulsacc.edu/about-tcc, retrieved August 2, 2013)

Current TCC Students

According to the NCES' IPEDS College Navigator, as of Fall 2011, a total of 20,154 students were enrolled, with 985 students classified as "undergraduate transfer-in" enrollments. Regarding enrollment status, 39% of students attend full-time and 61% attend part-time. Approximately 38% of students are male, and 62% are female. A total of 63% of the undergraduate student body self-identified as White/Caucasian, 10% as Black or African American, 9% as American Indian or Alaska Native, 6% as Hispanic/Latino, 3% as Asian, 1% as Non-resident Alien, and 5% as two or more races. Race ethnicity unknown was reported for 3% of students. Of the students, 55% were 24 years of age and under, while 45% were 25 and over. A vast majority (93%) were in-state students, while 7% were reported as "unknown."

Of first-time students attending TCC in Fall 2010, 55% of full-time students and 34% of part-time students returned in Fall 2011. Of those first-time, full-time students who began their program in Fall 2008, 28% graduated or transferred out into another degree program within 150% "normal time" to complete their program. Graduation rates within 150% of "normal time" for those who started in Fall 2008 were 10% for males and 15% for females. The within 150% of "normal time" graduation rates differed by race/ethnicity, and were as follows: American Indian or Alaska Native: 10%; Asian: 14%, Black/African American: 7%, Hispanic/Latino: 9%; White: 14%; and Non-resident alien: 14%.

The IPEDS data from Fall 2011 reports the student-to-faculty ratio of TCC is 18:1. The institution had 305 employed full-time faculty and 843 part-time faculty, all primarily serving in instructional roles.

The AAS in Information Technology Degree Program

Curriculum design. The Information Technology AAS workforce development degree program at TCC is designed to "provide students with the skills needed to work in today's rapidly changing information technology environment" (http://www.tulsacc.edu/programs-and-courses/catalog-2012-2013/degree-certificate-programs-2012-2013/information-technology#it3, retrieved August, 2, 2013). When we visited the program in Spring 2012, nine degree options were available, including:

- Business Application Professional
- Cloud Computing
- Information Technology (Flexible)
- Mobile Computing Development
- Networking
- Programming
- Systems Support Technician
- Web Development
- Website Management

During a subsequent review of the degree program website in August 2013, our research team discovered that these options had been reduced to eight, with "cloud computing" removed from the list.

Each of the degree options has a specific set of courses associated with it, requiring 27 credit hours of degree option coursework. The Information Technology option – the focus of this report – is described as seeking "to provide maximum flexibility in designing a course curriculum through electives which meet the needs of students in the Information Technology field" (http://www.tulsacc.edu/programs-and-courses/catalog-2012-2013/degree-certificate-programs-2012-2013/information-technology#im2, retrieved August 2, 2013). Students select 27 credit hours of degree option coursework from any CSCI, CSYS (Computer Information Systems) or ITCV (Information Technologies Convergence) courses.

In addition to the degree option courses, students complete 18 credit hours of General Education requirements. This includes 6 credit hours of English courses, 3 hours of math (either Business Mathematics or College Algebra), 6 hours of social sciences, and 3 hours of speech communications. Finally, students complete 15 credit hours of core courses, including a 3 credit hour business course and four computer information systems courses that total 12 credit hours. In sum, the AAS degree requires 60 credit hours of coursework.

Faculty Roles and Positions

At the time of our site visit, there were eleven faculty members teaching the AAS in Information Technology courses at TCC Northeast. One program administrator served as the Associate Dean for the program on the Northeast campus who is "responsible for the program… the buck stops [here]. If the classes aren't making, if we're not meeting students' needs, if the instructor needs new software," the Associate Dean takes care of the program needs (EE, p. 9).

At the Northeast campus there are three full-time faculty. Across all four TCC campuses, there are 14 – 15 full-time faculty. The standard course load for full-time faculty members is 15 credit hours per semester (5 classes, 3 credit hours per class). Overload classes are allowed for an additional 15 credit hours per year total, paid at the same rate as a part-time load. Full-time faculty are also responsible for writing the curriculum, which is then shared with part-time, adjunct faculty members.

At any given time, there can be 20-30 adjunct faculty members on the staff at the TCC Northeast campus. The Southeast campus can have 40-50 adjunct faculty, "because they've got so many more classes that they offer there. They've got so much more space" (EE, p. 14). Part-time faculty are on semester-to-semester agreements. There are no contracts available to adjunct faculty "and they understand that" (EE, p. 15).

Articulation Agreement between TCC and OSUIT

Developing the articulation agreement. An articulation agreement has been in place between TCCs' AAS degree in Information Technology and Oklahoma State University Institute of Technology's BT in Information Technology since 2004. At the time the agreement was created, according to one institutional administrator at TCC, the college had been heavily involved in the CyberSecurity Education Consortium (CSEC). As on program administrator put it, the articulation agreement between degree programs "was just kind of one of those, 'hey, is this something we ought to work on?' 'Yeah, great.' We punched it up; the president signed it." (EE, p. 4). The agreement is commonly referred to as the "Information Technologies Partnership Program." The smooth process of building the agreement was facilitated by working across campuses with individuals that already had strong relationships – "having someone that you work with, that you trust" (EE, p. 3).

The IT Partnership Program does bring some noted differences to the AAS degree program experience for TCC students in that the course choices are more restricted for students who intend to transfer to the BT program and would like to carry their credits with them, as compared to AAS student who do not intend to transfer. For example, the AAS degree program allows students to choose among three courses for their second English course in the General Education requirements: (a) ENGL 1213 Composition II, (b) ENGL 2333 Technical/Professional Writing, or (c) Business Communication I. For students wishing to transfer credits to the BT program, ENGL 1213 Composition II is prescribed as a required course. Additionally, in the degree option courses, the Information Technology option allows AAS degree students to select 27 credit hours from any CSCI, CSYS or ITCV courses. Students wishing to transfer to the BT degree program have nine courses prescribed from which they can choose to fulfill these 27 credit hours.

A New Chapter – Bachelor's Degree Courses Offered at TCC. Approximately three years prior to our site visit team's visit in March 2012, TCC and OSUIT started a "new chapter" in their articulation agreement relationship, in which OSUIT would offer the BT in Information Technology courses on TCC's campus. The possibility of this type of relationship had been discussed for many years beforehand, yet the project had not been taken on for many reasons. As described by an OSUIT program administrator:

> Tulsa Community College at the time was going through a revamp of their curriculum, so it took a little while for everything to get settled there. We [OSUIT] were changing some things on our side because our baccalaureate was changing from a BT in Information Assurance and Forensics to at BT in Information Technology. So when both of those were set, then we had faculty come up, and they sat across the table, and they talked. (EE, p. 5)

From the start, there was strong interest on the part of TCC for pursuing a partnership with OSUIT to offer courses for the BT on their campus. As one TCC program administrator reflected:

> It's just one of those situations where it was a good idea; everyone was going to benefit. TCC could benefit; we could benefit. Obviously, students could benefit. The local business and industry could benefit. It seemed like something we ought to do. (EE, p. 5)

However, the implementation of this partnership on the TCC brick and mortar campus was a bit more challenging than the development of a traditional articulation agreement on paper. On a basic level, questions about logistics emerged – "What keys are you going to have? Should you check it in, check it out? You've got copiers with codes on them and all this sort of thing." (EE, p. 3). Beyond basic logistics, institutional culture and territory questions began to arise. One program administrator described the challenges as follows:

> TCC is a faculty-driven institution. And by that, what I mean is this: Associate deans, administrators, do not control curriculum, do not write curriculum, period. Our faculty do. And our faculty, especially since we're open enrollment, they have to make their load to get paid, and then, they can teach some additional classes and make additional monies. They had all sorts of concerns.
>
> Their concerns to me were, "Well, wait a minute. What classes are they putting on here? Are they going to be in competition with my classes?" Because with open enrollment, if the enrollment drops, my class doesn't make, you know, "You're hurting me."
>
> The second thing was, "What resources have they taken away from me?" Because we have very limited resources. We're a public institution; our funds are limited. Are you going to get a whole bunch of new computers instead of putting them out with faculty and the areas that we need? They're going to OSUIT?
>
> And so, they had a lot of questions that I just didn't think about, you know, but it's their bread and butter. (EE, p. 5)

So, beyond the straightforward process of looking at where the curriculum aligns, TCC and OSUIT encountered deep-seated questions related to the bringing together of two faculty bodies on one campus. What on the surface seemed like a natural connection to benefit the students – bringing an applied bachelor's degree opportunity to their location – led to a host of other questions about job security, use of space and resources, and curriculum control for another key stakeholder group, the TCC Information Technology faculty.

Other key stakeholder groups also raised questions about the new arrangements for offering OSUIT's BT courses on TCC's campus. As a TCC program administrator shared, "our academic compliance people wanted to know all sorts of things as well" (EE, p. 6). How would requirements for the Higher Learning Commission be met within this new relationship? If classes were not going well and changes needed to be made, how quickly could changes be made? If changes in classroom configuration would be needed, how would faculty be informed? Who would approve such changes? What type of IT support would be provided to the OSUIT faculty, particularly as they "needed a very secure area because they were going to be working on all of these highly – what could be volatile… viruses" (EE, p. 6).

One TCC program administrator reflected that the transition time to setting up this articulation and establishing the OSUIT BT programs on the TCC campus was full of "a lot of it was just what-ifs, because they want to know," and that "all of these things can really hold up a program, but we got through it" (EE, p. 6). Two key factors helped their department move through these challenges – clear communication and trust.

> Communication is a huge part of this… to our faculty's credit, they listened, and I have a good relationship with them, which I'm thankful for…
>
> But if we didn't have that trust, we could not have gone on because if they did not trust me and if they did not trust [the OSUIT Department Chair], and they felt like their classes were going to be affected, that our enrollment was going to be affected, that the resources were going to be affected, then they could have gone up as a faculty association and said, "We do not want this," and that would've been it. It would have had to have stopped. And so, I have to give them big credit for the trust.
>
> The same way with IT people. Our IT people could have said, "We just can't do this. Building this for them and getting them the resources that they need, it's just too much. We don't have enough of our own." And they could've stopped it. Our compliance and academic people could've said, "This won't work. We can't do this."

So any of them could have stopped the whole project. But they didn't. They listened, and we worked together on it, and I really credit [the OSUIT Department Chair] and OSUIT a lot with that because if they weren't good partners, if we hadn't worked with them before, if the faculty didn't know them, if the compliance people didn't know them, if the IT people didn't know them, some of the things that could help us were some of the IT people have gone through those OSUIT programs, so they knew and understood what it was like out there.

If I had to prioritize, there's a million things down this thing that have to happen, that have to work. But number one, if there's not trust there, if people aren't willing to work together, then whatever you come out with at the very end probably is not going to be what you wanted. (EE, p. 6-7)

Ultimately, TCC solved some of the space and resource questions by keeping the programs running in separate spaces and classrooms for a while. In that way, challenges could be avoided with equipment being left in different states – computers reconfigured, pencils missing, file cabinets moved – "even in the best of situations those things can happen" (EE, p. 7), and TCC program administrators did not want to provide opportunities for resource difficulties to arise between campuses.

Sharing What Works; Program Quality

Collaborations to strengthen quality and effectiveness.

Industry advisors. One program administrator spoke of the central role of workforce development committees in the development and enhancement of degree programs at TCC, providing information on "their [employer] needs, the training that they need, where they see things are going" (EE., p. 10). The workforce development committee for the Information Technology degree program meets with faculty at least annually to discuss how the degree program and individual courses are meeting industry needs. Faculty then take what they learn from these meetings and consider the information against their own research on the field to make programmatic decisions

> Who's offering [programs or courses in this area]? How do we meet industry standards? Do we have the capability to meet industry standards? Do the people we have right now in IT have the training they need? Do we have the tools? Do we have the machinery? Do we have, all of these things? And so, if we do, then an Associate Dean works with their faculty in that area, and basically they put together a program. (EE, p. 10)

One example area in which ideas from the workforce development committee were used to enhance the Information Technology curriculum was in the development of an Ethics in IT course. Industry professionals raised awareness that "IT professionals have access to information that maybe only the president would have access to. Have they been trained how to deal with seeing, hearing, knowing, any of those things? Probably not." (EE, p. 2). Recognizing the need, a TCC faculty member developed a standalone course in this area that articulates with their Information Technology degree.

One program administrator at TCC also mentioned at their program faculty were revisiting the structure of their advisory committees. This discussion emerged after a recent visit and review of other institutions' advisory committees, including OSUIT which they found to be "very impressive… a very incredible process" (EE, p. 17). TCC program administrators and faculty are carefully considering questions such as: "What are the advisory committees really doing for us? And, are they doing what we need them to do? And, are they people that we should have?" (EE, p. 17) Revisiting this process was important to the TCC faculty and program administrators because they wanted to confident that their advisory committees could "back [them] up" (EE, p. 17) when difficult inquiries and decisions needed to be made regarding program improvements.

Sharing What Works: Educational Significance

Individual and societal needs addressed by the program. One program administrator at TCC spoke about the challenges that students encounter wading through all of the higher education degree options – "They want to know 'which is best for me?' That's a trick, because it's not one size fits all with AA's, AS's, or AAS's, so literally it is student by student" (EE, p. 1). He described the value of AA and AS degree tracks as offering more general education courses, such as history and chemistry, as opposed to "specialty classes." These pathways were a good fit for students who intended to transfer to a traditional bachelor's degree. He then described the AAS degree as "kind of the opposite of that," saying:

> You're going to have some general [education classes] that are required, but you're going to get all these specialty classes. So students very often, and especially if they're working or they're looking to go to work, that's what that degree, to me, is meant for. Because they can go right to work hopefully. We give them the skills to go right to work.
>
> Does that mean it should stop right there? More and more, I would say absolutely not. In fact, the Bachelor of Technology, if I was an employer, would be highly desirable to me. That's where I would look, because I know those students have completed all these specialty courses, but I also know that they can write, that they can do all of these other general [education] things that probably are important, especially as they move up into supervisory and management positions. (EE, p. 1)

For this program administrator and faculty member, the applied degrees represented an opportunity to bridge the gap between skill development and "also helping [students] with all the human relations" (EE, p. 2) skills that were needed to function in the world of work. Specific human relations skills that he mentioned included topics such as writing, public speaking, interacting in customer service roles, and ethics in information technology.

The challenge for students who pursued the AAS degree has been, in the past, the low number of general education courses for those who chose to pursue a bachelor's degree. As described by one program administrator:

> When they went out to the OUs [Oklahoma Universities] or the OSUs [Oklahoma State Universities], that sort of thing, they said, "Well, you've got to have 60 credit hours of general eds." "Well, but I only took 18." "Well, sorry, you've got to go take the rest of those." And so, they would have 90 credit hours just to get up to where they could go in as a junior. And then, they're going to add an additional 60. (EE, p. 18)

For these students, pursuing a traditional BA or BS degree meant adding an additional year of coursework to their bachelor's degree journey – a difficult path for many student to embark upon.

The BT degree, however, presented a new opportunity – "as long as they're following this plan, and we try to make it as straightforward as possible, they're going to go over to OSUIT and they're not going to lose credit… it's an incredible opportunity" (EE, p. 18). Program administrators recognize that this degree pathway is "not unheard of" (EE, p. 19). Northeastern State University was offered as another example of an institution that offers the BT degree, however their BT degree offerings were not viewed as being in fields that were well connected to TCC's AAS degree in Information Technology. One program administration recalled Northeastern State University offering BT degrees in areas such as firefighting. In our review of the Northeastern State University website, the only BT degree that we were able to identify was a BT in Technology offered within their College of Business and Technology, Department of Information Systems and Technology. In this degree program, students work with an advisor to create and "individualized program of study… in order to meet specific career objectives." Emphasis areas

have been developed in for service occupations, manufacturing, and supply chain logistics. Information retrieved from http://catalog.nsuok.edu/preview_program.php?catoid=11&poid=940&returnto=295 August 29, 2013). The partnership that TCC has with OSUIT is viewed as a rare and special opportunity to offer a bachelor's degree pathway specifically related to Information Technology.

The significance of the Information Technologies Partnership Program was expressed by a TCC program administrator as creating a situation where "those AAS [degrees] are no longer just terminal degrees. More and more, employers are looking for people that have gone on and completed [the bachelor's] degree" (EE, p. 19). The BT degree pathway is facilitating a realistic pathway to bachelor's degree completion for students who did not have this option in the past.

In fact, this is part of the motivation for TCC partnering with OSUIT. As expressed by one program administrator:

> The AAS degree, which was the terminal degree, won't even get you to where you need to be with these employers. So that's what I see happening. And if we don't offer that to our students, then what's going to happen to the students? They're going to know that before we do. And they're going to say, "Why would I go there, because I can't even get a job. I need to go straight here." And so, that opportunity, that's true, we're providing that access to our students, but we're also ensuring our future as well. (EE, p. 19)

As demonstrated in this quote, there is the sense that the AAS degree will soon not be sufficient for employment. Once students recognize this, TCC could be left behind if they do not offer a viable baccalaureate degree pathway.

Supports to help students achieve positive results and outcomes.

Dedicated faculty and advisors. With the BT degree courses offered on the same campus as the AAS degree courses, students have the added advantage of faculty and advisors for each program being well acquainted. Students can…

> finish your AAS on Friday, and you could conceivably start your BT, and literally walk a few steps down the same hallway, and you're here. I mean, so it's all familiar; there's no shock to your system. That was really the underlying concept behind doing this. As opposed to figuring out how to get them someplace else and get them plugged into a different climate. (EE, p. 20)

Instructors in each program know each other by name; they can make recommendations and help the students build relationships across the programs. Additionally, students "have the same access to advisors at either of the places" (EE, p. 21) so that they may be "co-advised as they go through the process, to make sure no one is slipping through the cracks" (EE, p. 21).

Tutoring. Faculty in the Information Technology program highlighted the FACET Center that is available to all students on the TCC Northeast Campus. The FACET Center is "an interactive learning facility" which offers "a place to experiment with technology, acquire and test new knowledge, grow, and even play academically" (http://www.tulsacc.edu/campuses-and-centers/northeast-campus/northeast-services/northeast-campus-facet-center, retrieved August 5, 2013). Free services are provided to students in the following areas: computer access, English tutoring, math tutoring, American sign language tutoring, and computer help. Help is provided on both in individual and workshop formats in all of these areas.

Student organizations. TCC also offers a number of student organizations to support both academic and social development of students. A few student organizations mentioned by administrators of the

Information Technology program include those for African American males, Latino/a students, Phi Beta Kappa, and business clubs. This program administrator added: "if a student wants and needs support in any area, it's there for them" (EE., p. 8).

College strategies class. Students also have access to a college strategies course, "which a lot of four-year [colleges and universities] actually require" (EE, p. 8). This course walks students around campus, teaches them about basic computer skills and programs such as Microsoft Word and Excel, and talks about keys to success at TCC. Faculty have found that the course "has become more and more popular here at TCC in helping beginning students" (EE, p. 9). One administrator verbally shared that the course was correlated to a "significant bump in retention… 15% or something" (EE. p. 9). In response, TCC faculty "have gone further," working to integrate the material from the college strategies class into other introductory classes. As an example, he shared that "we've got it integrated with a computer concepts class… The instructor not only teaches his or her class, but they also have that strategy as well" (EE, p. 9). This program administrator reports that they have found that "when we integrate it actually with a class, it [the college strategies material] does even better" (EE. p. 9).

Sharing What Works: Evidence of Effectiveness and Success

Enrollment. Program assessment "at the microscopic level" begins with looking at course enrollment – "does this class make or not make?" (EE, p. 11). Enrollments are tracked for "every class, for every part of term, for every semester" (EE, p. 11). According to one administrator, "six or seven [students] may be enough for a specialty class, because it's so highly specialized…but if I've got a really general class… I need 10, 15, or 20 before I can even go forward [with continuing the course]" (EE, p. 11). Conversations with administrators and explorations into TCC seem to indicate that enrollment is the main driver of evaluation in terms of programs and courses.

According to data on the Planning and Institutional Research Office website, the most recent available enrollment data across the Information Technology degree was as follows: Summer 2011: 18; Fall 2011: 62; Spring 2012: 71 (http://pir.tulsacc.edu/sites/default/files/u2/Enrollment%20By%20Major%202011-2012.pdf, retrieved August 2, 2013).

Graduation and transfer. Based on records provided in the Planning and Institutional Research Office website, a count of program graduates in the 2011-2012 academic year shows that 2 students graduated with an AAS in Information Technology in Fall 2011, and 2 students graduated with an AAS in Information Technology in Spring 2012. Our research team has no way to determine if these are "typical" gradation numbers for this degree program, or if the faculty have a sense that more students are completing coursework than are filing for graduation (as was expressed at other community college sites).

When considering student expectations to transfer from the AAS degree in Information Technology at TCC to the BT in Information Technology at OSUIT, program administrators and faculty at TCC anticipate that high percentages of their students plan to transfer. As described by one program administrator:

> The only data I have would be anecdotal. It's not that we've sat and I've gathered data and that sort of thing. I would say that if I went into the IT classrooms and I said, "Hold your hand up if you're going to OSUIT." Out of 10 people in there, probably 6 would raise their hand. And then, I'd say, "Okay, if you might consider it in the future, how many of you would?" And I really honestly think 10 out of 10 would raise their hand. Because if they're not already planning, they're going to start thinking about it. (EE, p. 19)

Of course, it is recognized that there exists a gap between intentions and implementation, and there are many "speed bumps" (EE, p. 20) that students may hit along the way that change their plans.

The Dean of University Transfer at TCC "recently gained responsibility for [tracking the transfer of] AAS degree recipients" (EE, p. 12) in addition to other student groups on campus. As such, additional data may become available on this group in the future. Currently, the data that we were available on the Planning and Institutional Research Office website lumps all students transferring from TCC to OSUIT (all majors, all degrees) into a single table. This data can be seen in Table 28 for the years in which the articulation agreement between the AAS degree in Information Technology at TCC and BT in Information Technology at OSUIT has been in existence. In those years, a total of 57 students have transferred between the two institutions. A subset of these 57 students can be expected to be participating in the Information Technologies Partnership Program.

Table 28. Total number of transfer students from TCC to Oklahoma State University Institute of Technology in All Degree Programs*

Academic Year	Total number of transfer students TCC to OSUIT
2003-2004	4
2004-2005	6
2005-2006	9
2006-2007	3
2007-2008	7
2008-2009	7
2009-2010	5
2010-2011	7
2011-2012	9
TOTAL	**57**

Retrieved August 2, 2013 from: http://pir.tulsacc.edu/sites/default/files/u2/Transfer%20Summary%20by%20Institution%202002-03%20to%202011-12.pdf

Employment Outcomes. Employment outcomes are not currently tracked for certificate or associate degree graduates from TCC's Information Technology programs. One program administrator reflected:

> We're going to have to do a better job with that… We're going to need to know how many of them are going to work. And if they're not going to work, what happened to them? Because that's part of the reporting requirements. (EE,p. 13)

Currently, the little information that they do have is anecdotal. They find out about student employment when instructors build strong relationships with students, and students return to share news of their

successes or to ask for letters of recommendation. There are some informal means to "try to kind of keep track of that" (EE, p. 13), yet there is a recognition of the need to formalize this process.

Recognition of need for additional evaluation approaches. Breaking into the area of program outcomes assessment has been "a learning process" (EE, p. 16) for the Information Technology faculty and program administrators at TCC. One program administrator shared how, on their campus, "everybody is going to do assessments, and here's how you're going to do them, sort of, but the rest is up to you" (EE, p. 16). Yet, the transition to this style of assessment has been challenging because it seems to require a "different mindset" from what is familiar in technical programs.

> When I sit with the faculty members here, we don't really discuss "How are your outcomes? How are your assessments? How are your" – In fact, assessments are something that's brand new to us. We just started this…
>
> Our faculty members write the curriculum based on their experience. At the end of class, a student will be able to (a), (b), (c), (d), you know, work this, turn this, calculate this…
>
> So we have this hodgepodge right now. I think that was the reason that they kind of reworked our whole structure, so that we could get a Dean of Assessment, so that we could kind of get this orchestrated together. (EE, p. 16)

Hope was expressed that with the help of the new Dean of Assessment the Information Technology faculty and program administrators could find new ways to gather and evaluate data in ways that could inform decision making about their degree program.

Sharing What Works: Replicability and Usefulness to Others

In terms of what lessons and approaches TCC staff thought might be useful to other institutions and organizations, building upon personal relationships and the strong sense of trust between TCC and OSUIT was heavily cited. Administrators recognized it as a good model for starting a partnership. Faculty members at both institutions know each other well and can communicate effectively when questions or issues arise. It also helps with student advising – faculty members at TCC know the staff at OSUIT well and they can make recommendations to students as well as provide more information about specific courses and curricula.

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