PROGRAM REVIEW

**AS/BS IN NETWORK & SECURITY
ADMINISTRATION (NETSEC)**

**Beacom College of Computer and Cyber Sciences
Dakota State University**

Review Conducted April 4, 2022, by:

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PART 1: Executive Summary

Dakota State University is well-known across the country for its pioneering cybersecurity program. DSU is one of the first (if not *the* first) schools in the nation to offer a Cyber Operations major. They hold all three NSA National Centers of Academic Excellence designations and were in the inaugural class of Cyber Operations designated schools. DSU has been a national finalist in the Collegiate Cyber Defense Competition 7 times since 2009. DSU has been awarded numerous grants for leadership and service activities in the cyber ed community, including conducting faculty development workshops and hosting NSA GenCyber summer camps. Based on my observations from the site visit conducted on April 4, 2022, in Madison, South Dakota, DSU's national reputation is well-deserved.

DSU's AS/BS Network Security Administration (NetSec) degree program is mission-aligned, has appropriate goals, and is achieving good results. The program has excellent resources in the areas of faculty, technology, facilities, and financial support. The curriculum is up-to-date and hands-on—both vital features of quality cybersecurity-related degree programs. DSU integrates technology into the curriculum through their tailor-made Information Assurance Lab and through their state-of-the-art facilities, including their Academic Server Room. DSU's thoughtful integration of technology enables them to offer the same lab experiences to both in-person and fully online students. As the state of South Dakota's designated state university for tech-related degree programs, the NetSec program attracts students from across the state. Additionally, through their national reputation and with the help of their exemplary GenCyber summer camps, the NetSec program draws students from across the country. The NetSec program has solid student enrollment and provides generous scholarship opportunities to students through federally funded grants. Students are well supported by faculty and find good jobs upon graduation. In the most recent year where data was available, the AS and BS degree programs had 100% job placement. Student retention rates are above the national average.

Two areas that DSU needs to continue developing are their faculty recruitment and retention program and their NetSec assessment program. DSU's cyber faculty are their greatest asset and the primary reason for the program's success. The demand for cybersecurity higher education is growing across the nation and market competition among colleges and universities for faculty is fierce. A failure to recruit and retain faculty poses the most significant risk to the NetSec program's continued success. A better structured assessment program is the next step in the NetSec program's maturation and will take the program to new heights. The program's administrators have identified a project plan and reasonable timeline to implement continuous improvement best practices, and they are committed to completing this initiative and have the support they need to accomplish it.

PART 2: SCHEDULE OF ON-SITE VISIT

Overview

Visit Date: 4 April 2022, 9:00AM
Location: Heston Hall, Beacom Institute of Technology
Faculty Contact: Dr. Kyle Cronin, Kyle.Cronin@dsu.edu

Details

Time	Activity	Location
9:00–9:45 AM	DSU Provost, Dr. Richard Hanson	HH306
9:45–10:00 AM	Beacom College Dean, Dr. Pat Engebretson	BIT207
10:00–11:30 AM	NetSec Faculty	BIT235
11:30–12:30 PM	Student Interviews	BIT235
12:30–1:30 PM	Lunch w/Select NetSec Faculty	TBD
1:30– 2:00 PM	NetSec Program Coordinator, Dr. Kyle Cronin	BIT208
2:00– 2:30 PM	DSU Facilities and Lab Environment, Mr. Eric Holm	BIT325
~~2:30– 3:15 PM~~	~~Assessment Specialist, Dr. Jeanette McGreevy~~	~~Zoom~~ *
3:15–4:00 PM	Overflow time/Exit Interview Prep	BIT235
4:00–5:00 PM	Exit Interview, Drs. Hanson, Engebretson, Cronin	BIT235

* My interview with Dr. McGreevy was rescheduled to a Zoom call on April 8.

PART 3: PROGRAM EVALUATION

1. Program Goals and Strategic Planning

Since 1984 DSU's mandate from the state of South Dakota has been to "develop technology-based degree programs in information systems, business, teacher education, and allied health care services at both the undergraduate and graduate levels" (NetSec Self-Study, 2021). The NetSec program is well-aligned with this university-level mission. This program develops and prepares graduates for cybersecurity roles in information technology (IT). Additionally, DSU is a pioneering program in cybersecurity and has stayed ahead of the curve of national trends and forecasts for the discipline.

The specific mission of the NetSec program is to equip students with "the skills necessary to manage the information technology infrastructure required to operate a modern business" (NetSec Self-Study, 2021). This is an appropriate and in-demand mission. IT cyber skills are in high demand because reliable and secure IT is critical for all modern businesses and organizations since cybersecurity attacks are an ever-present threat. Market forces attract students to degree programs like NetSec because of strong job prospects and high salaries. The return on investment for students enrolled in NetSec at DSU is high and will remain high for the foreseeable future. This degree program a worthy investment for DSU and the state of South Dakota and has strong potential for continued growth.

2. Program Resources

DSU's NetSec degree programs have outstanding resources, including faculty, technology, facilities, and financial support.

19 faculty are listed as teaching in the NetSec degree program in addition to adjuncts. 9 of the faculty have terminal degrees and 10 have MS degrees (NetSec Self-Study, 2021). During my site visit, I interacted with 6 faculty members at length, and they all demonstrated a passion for cybersecurity and teaching. They have a strong work ethic and are committed to the success of DSU's cyber programs. My interview with several DSU students reinforced my impression that faculty are highly competent and devoted to their students.

One way the DSU faculty demonstrate their passion and competence is through the outstanding IT infrastructure they have established and maintain in support of DSU's cyber-related degree programs. By being active practitioners of their craft, they stay up-to-date with technology, and this continuous education is leveraged in the classes they teach. Many students enrolled in higher ed cyber degree programs have to pay for access to cloud labs provided by third party vendors, but students at DSU have access to high quality labs free of charge through their outstanding in-house infrastructure.   DSU's technology infrastructure includes the Academic Server Room (ASR) that houses 90 servers to which students have direct physical access. DSU also has an additional block of servers that support their Information Assurance (IA) Lab. The IA Lab runs VMWare and provides Infrastructure-as-a-Service (IaaS) to faculty and students. In my opinion, DSU's "cyber range" (not a term DSU uses) rivals that of any university.

An area of concern with faculty is loading. Instructor positions teach 5-5 loads and professor positions teach 4-4 loads. This is a significant amount of teaching responsibility, but not uncommon among teaching institutions like DSU. However, due to program growth, some NetSec faculty teach multiple extra courses as overloads. Faculty have done well to streamline course management, assignments, and grading through their learning management solution, but educational quality inevitably diminishes with extra loading. Additionally, faculty stress increases with the additional responsibility which could lead to burnout. DSU currently has 6 open faculty positions to help address this issue. These positions need to be filled to maintain the program quality that has made DSU's reputation.

Another area of concern is that most, if not all, NetSec program faculty are DSU-educated. One major benefit of this is a high degree of program loyalty among the faculty, but a drawback is program insularity that could limit exposure to alternative practices and approaches to cybersecurity education. DSU produces many qualified faculty candidates through their advanced cyber-related degree programs, and it is natural that they would recruit from this pool of alumni. In fact, due to the rural location of DSU, "growing their own talent" is a smart and necessary strategy. However, a larger investment in nationwide faculty recruiting, and offering nationally competitive faculty salaries, could draw unaffiliated faculty to DSU, and this academic diversity would enrich DSU's cyber programs.

The NetSec facilities are outstanding. The Beacom Institute of Technology (BIT) was built in 2018 exclusively to support DSU's cyber programs. It is a beautiful facility that was constructed with growth in mind and has remaining capacity. East Hall, the oldest building on campus, is also utilized by the NetSec program. It was recently renovated with like new classrooms and offices. Another cyber-related facility on campus, Madison Cyber Labs (MadLabs), is even newer and larger than BIT, and houses research initiatives for faculty and students. The NetSec program has benefited substantially from these extraordinary capital investments.

Clearly, DSU's cyber programs, including NetSec, enjoy incredible financial support, both through private donations and the state of South Dakota. A pledge of $30 million was recently made by the state to continue growing DSU's cyber program. Funds like these have been well used to build facilities and procure hardware and software to support the cyber programs at DSU.

3. Program Curriculum

The NetSec degrees prepare students for jobs such as "system administrator, network systems engineer, systems analyst, network analyst, network application developer, and technical consultants" (DSU NetSec website). The AS degree is a 60 hour, 2 year degree program that efficiently prepares students for in-demand jobs in IT cybersecurity. The AS degree is a subset of the BS degree. The BS degree is a 120 hour, 4 year degree program. Most AS students matriculate into the BS degree program, making the BS degree the main NetSec program. Through clever curriculum design, the first year of the NetSec major is identical to the Cyber Operations and Computer Science majors. This not only leverages institutional resources efficiently but benefits students by allowing them to delay their decision to choose a specific major until the second year.

The NetSec program curriculum is current, thorough, and hands-on. The NetSec programs are kept up-to-date through the continuous education of the faculty. It is common for courses to be updated on an annual basis. The curriculum is also thorough. In addition to a general operating systems course, the students take specific courses for both Windows and Linux operating systems. There is a heavy emphasis on computer networking, with 21 hours of network-intensive coursework. Students also take multiple cybersecurity specific courses that cover risk management, software security, and network security. Applied cryptography, the foundation of much of cybersecurity, is also covered and reinforced throughout the curriculum. DSU's cyber curriculum exceeds cybersecurity education national standards such as Cybersecurity Curricula 2017.[1]

The NetSec courses are hands-on and utilize DSU's outstanding lab infrastructure. Faculty can develop and deploy labs quickly thanks to DSU's IA Lab, relieving a significant barrier that cyber faculty face in trying to keep labs current. Faculty can create complex network topologies and roll them out to every student in minutes. Through the ASR, every student in the CSC 437 Survey of Enterprise Systems course has exclusive access to a server that they configure from scratch to support the IT infrastructure that a typical business or organization would require. DSU does not have a senior capstone course, but this course accomplishes a similar objective— helping students transition to real-world work environments. Additionally, students received work-based learning opportunities through either an internship or a research experience which is required for every student. I interviewed several students during my visit, and they exuded confidence in their education—this comes from recognizing they have been equipped to go into the job market and make an immediate impact.

Of DSU's three cyber-related degree programs (NetSec, Cyber Operations, and Computer Science), NetSec is the most IT-focused and leans more towards training than education. This is both a strength and a weakness of the NetSec program. NetSec emphasizes equipping students with competencies that can be used immediately upon graduation, and employers appreciate college hires with developed practical skills. However, the NetSec program's training emphasis limits the number of theory courses, such as math courses, required for the major. Theory courses are useful for developing rigorous critical thinking skills that help "future proof" students against the ever-changing technological landscape. Many computer science-based cybersecurity programs require at least 6 hours of mathematics including discrete math (ABET Criteria for Accrediting Computing Programs, Cybersecurity, 2022 – 2023).[2] However, the NetSec program's only math requirement is a 3 hour Intro to Statistics course. I believe this trade-off is acceptable, but it does make the NetSec degree more IT-based than computer science-based.

4. Technology Integration

As mentioned previously in this report, technology integration is a strength of the NetSec program. The hardware and software resources available to students through the ASR and IA Lab would rival those of any university. These resources are leveraged to enable online students to complete the same labs in the same fashion as in-person students. Even in the hands-on

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[1] https://www.acm.org/binaries/content/assets/education/curricula-recommendations/csec2017.pdf
[2] https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-computing-programs-2022-2023

routing and switching classes which involve physical Ethernet cables, online students can virtually "plug-in" cables to virtual switches and routers. In classes that involve mobile phone and Wi-Fi hacking, online students have online access to physical smartphones and routers that are housed in a Faraday-shielded cabinet, enabling them to complete the labs using real, not simulated, electromagnetic waves and signals.

My program review did not include an evaluation of the learning management solution nor the online course delivery experience (e.g., lecture videos).

5. Program Assessment

Partially due to Covid disruptions, NetSec program assessment has not been rigorous for at least the past two years. I believe continuous improvement is occurring because faculty care about their courses and update them regularly, but without a rigorous assessment program, there is little quality assurance for determining where there may be weak or overlooked areas. As the NetSec program grows, implementing quality assurance best practices will become even more vital. It will help ensure that all faculty, including adjuncts, are teaching the appropriate content, that multiple offerings of the same course are equitable, and that student learning is taking place.

Without good course outcomes tied to appropriate assessment, it is difficult to maintain a high quality program. Fortunately, DSU has recently invested in assessment software called the Trojan Assessment Profile (TAP). I reviewed TAP and am impressed with its functionality. It allows DSU faculty to document, organize, and maintain continuous improvement processes. However, TAP is only as beneficial as the quality of its inputs. Course outcomes need to be thoughtfully crafted, clear, and assessable. It is important that the NetSec faculty evaluate all their program and course outcomes, map course outcomes to program outcomes, and input this data into TAP. Additionally, a continuous improvement plan and process, including a regular evaluation schedule, need to be implemented and adhered to going forward to ensure the continued quality of the NetSec program. DSU has a project plan and timeline in place for adopting TAP for the NetSec program and these updates will be evaluated during the next program review.

6. Student Support / Student Enrollments

During my site visit I interviewed 5 current NetSec students: 4 seniors and 1 junior. 2 of the students were from South Dakota and the other 3 were from out of state. 4 were double majoring in NetSec and Cyber Operations. Several of the students attended DSU's GenCyber camps while in high school and that was the primary means they were recruited to DSU. They were all aware of the national reputation of DSU and were proud to be DSU cyber students. They said the class sizes were small and hands-on focused, which they saw as a major benefit. Some of the students were recipients of full-ride scholarships through DSU's NSF CyberCorps Scholarship for Service (SFS) program or the DoD's Cyber Scholarship Program (CySP). 1 of the students participated in a prestigious NSA summer internship program. While not technically a representative sample of the NetSec student population (e.g., there were no online-only students), I believe the students provided honest and widely shared opinions.

I was impressed with the enthusiasm the students showed for DSU faculty. They noted that NetSec faculty were humble and earnestly sought feedback on end of semester student evaluations and often incorporate student feedback into their courses. The students felt supported by the faculty and they provided examples of times they reached out to faculty members and received help and feedback that exceeded their expectations. The students also told me about the many different extracurricular activities available to cyber students at DSU, including specific clubs focusing on malware, offensive security, defensive security, and computer programming. They were excited about the Collegiate Cyber Defense Competition team and the success they have enjoyed over the years. Extracurricular opportunities are crucial for developing a cyber culture and a love of learning among students, and DSU is doing this well.

The reputation of DSU's cyber programs have led to significant grant awards to fund student scholarships. These programs, including NSF SFS and DoD CySP, are a huge asset to DSU. DSU's reputation also opens doors to prestigious internship and employment opportunities for students.

At the time of my visit, 120 students were enrolled in the BS degree program with an additional 26 in the AS degree program (I was told it is likely that the majority of AS students will convert to the BS program). Overall enrollment has held steady the past couple years, but any trajectory assumptions must be viewed cautiously because of the disruption caused by Covid during both the 2020-21 and 2021-22 school years. Approximately one third of NetSec students at the time of my visit were double majoring in Cyber Operations. Both degrees contain several elective credits, and by choosing elective courses strategically, the double major can be accomplished by taking only 1-2 additional courses beyond the minimum requirements for either degree program. While I am not concerned about the double major from a curricular standpoint, it does make it difficult to determine enrollment numbers for the NetSec program. If the majority of NetSec majors are actually Cyber Operations-first majors, this would artificially inflate the enrollment of the NetSec program. However, it could also be the case that the double major is an attractive "bonus" of DSU's cyber programs, and this leads to greater enrollment in both NetSec and Cyber Operations.

The number of online-only students enrolled in the NetSec program was not a readily available data point. This metric would be helpful for DSU administrators as they consider future strategic investments. Online education is becoming even more popular post-Covid, and excellence in this area could extend the NetSec program's reach considerably. With the IA Lab environment they already have in place, I believe DSU is poised to offer an exemplary fully online educational experience. However, because online classes are currently managed in an ad hoc fashion by faculty, it will take a significant investment in time and resources to provide a consistent, high-quality online delivery experience on par with their in-person experience.

7. Program Strengths and Areas for Improvement

The greatest strength of the NetSec program is the faculty. The faculty are dedicated, highly competent, and passionate about cybersecurity and DSU. Another obvious strength is DSU's technology infrastructure and facilities. Considerable financial investments have been made in

DSU's cyber programs and have been leveraged to build outstanding facilities and resources for students.

One area of improvement for DSU is faculty recruitment and retention. Faculty compensation at DSU needs to keep pace with national trends. A recent ASEE Prism article illustrates how computer science salaries have grown in comparison to other engineering disciplines.[3] Cyber faculty salaries within the ranks of computer science faculty likely exceed the figures cited by ASEE. DSU Instructor salaries are exceptionally low for cyber teaching positions. Hiring faculty candidates with MS degrees is an emerging trend in cyber higher ed due to the shortage of PhDs in the cyber faculty job market. Therefore, Instructor salaries are on the rise. DSU currently has 6 open positions that need to be filled to maintain program quality. Meanwhile, they risk losing current faculty members to burnout and higher paying competitors.

Additionally, faculty are limited in their ability to supplement their university-provided income through grants. The current mechanism for supplementing salaries from grants is through teaching overloads, but this is an awkward workaround and exacerbates the problem of over-worked faculty. A better solution would be to increase faculty salaries or to provide extra stipends directly to faculty. If nothing is done to correct this issue, faculty might start finding revenue streams outside of grants awarded to DSU, or they may even stop pursuing grant opportunities altogether to the detriment of DSU.

Another area of improvement is program assessment. This is addressed at length in Section 5.

8. Specific Issues Identified by the University: Program Curriculum, Program Assessment, and Program Enrollments

No specific issues were identified by the University prior to the visit.

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[3] http://www.asee-prism.org/wp-content/uploads/2022/03/Databytes.pdf

PART 4: RECOMMENDATIONS FOR CHANGE

These recommendations are described more fully in the body of this report:
- Review faculty and instructor compensation policies to ensure they are competitive.
- Implement a robust assessment program in keeping with continuous improvement best practices.