COLORADO MESA
UNIVERSITY

2020 Technology Master Plan
December 28, 2020

Colorado Mesa University
Grand Junction, Colorado

Executive Summary

Colorado Mesa University's *Technology Master Plan* identifies and aligns Information Technology (IT) initiatives with the institution's strategic goals and documents the history of technology planning and the advancement of technologies towards these goals.

In August 2020, Colorado Mesa University's Board of Trustees approved the continuation of the *2020 Strategic Plan* through the end of 2021. It was determined to be advantageous to continue to work from the same planning documents as the University navigates this unprecedent global pandemic. The goals established in the *2020 Strategic Plan* are still relevant today: 1) Become the university of choice for students, faculty, and staff with a focus on academic excellence; 2) Increase the level of educational attainment in the region through quality academic programming; and 3) Continue the maturation of the University at all of its campuses.

Two decades into the 21st century, the information age has evolved into the age of experiences, fueled by the pervasiveness of mobile devices and the prevalence of wireless networks enabling anywhere, anytime access to media and applications. Students continuously engage in digital experiences, and they look for quality online experiences from their university of choice as well. A quality technology end-user experience is important to the growth of Colorado Mesa University—not only for increasing enrollments and student retention, but also for providing a quality education that meets student expectations for learning opportunities through innovation and digital resources. Moreover, the implementation of administrative systems that assist students through the enrollment process and to graduation and the use of data analytics by staff are important for effective and efficient University operations. Further, the security of applications and administrative systems and the protection of student privacy is paramount to the success of the University and continues to be a top IT priority.

Four technology trends were identified in the *2016 Technology Master Plan*: 1) bring your own device, 2) cloud services, 3) innovative learning environments, and 4) customer relationship management and business analytics. These trends are still important today and are foundational to moving through the age of experiences. As CMU moves forward, three technology trends must continue to be advanced: digital transformation in higher education, immersive learning experiences, and internet of behaviors—meaning the use of digital information available to influence behaviors. First, the student experience is at the core of digital transformation in higher education. It is important that CMU continue to create experiences—academic and administrative—that are seamless for the student, regardless if the services are delivered online or in person, the support is available by machine or by staff, or the learning environment is offered virtual or traditional. Second, a wider array of innovations will be based on immersive technologies as cost and ease of use standards are more attainable. While not new to the consumer, immersive technologies such as virtual reality, augmented reality, and mixed reality—where virtual and real worlds interact—will become more common in higher education. Third, student engagement has proven in recent years to be one of the most critical factors in student success, and CMU will continue to strive to improve student engagement using internet

of behaviors technologies. As the institution moves forward, the University will need to continue expanding information systems and infrastructure that ensure academic and behavior metrics better inform teaching and learning, extracurricular activities, and resource planning. The use of technologies to proactively identify students in need of support will require these metrics to be collected and operationalized to improve student success.

It is impossible to ignore the disruptions to higher education caused by the pandemic when updating the University's *Technology Master Plan*, and perhaps even more difficult, to predict how long the current disruptions will continue. The University, like all institutions across the globe, will need to consider that the current changes in education may last longer than the effects of the pandemic itself. Furthermore, the pandemic elevated existing education barriers for some students to new heights. Access to technology, whether due to living or work locations or the lack of financial resources, was exacerbated when the pandemic pushed students online and learning remotely.

Technology continues to play an integral part in achieving each of the University's 2020 strategic goals. The six technology initiatives established in 2016 are still current, and IT staff continues to use the following initiatives as the organizational structure for its goals and accomplishments section of the *Technology Master Plan*:
1) Improve business processes and institutional decision making through the use of technology;
2) Advance information security programs and business continuity planning;
3) Expand the digitization of content and services in support of the 21st century teacher/learner;
4) Improve access to online services regardless of physical locations and time of day;
5) Efficiently manage University resources; and
6) Advance campus technology in support of institutional initiatives and campus expansion projects.

Under each initiative, technology goals are aligned with the *2020 Strategic Plan* and accomplishments are documented. These accomplishments were possible because funding and institutional support for technology has been strong for more than a decade. How the University's response to the pandemic has influenced technology planning is included throughout the Information Technology Initiatives, Goals, and Accomplishments section.

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Introduction

The purposes of the Colorado Mesa University *Technology Master Plan* are to:
1) identify and align technology initiatives with the strategic goals of the University; 2) document the history of technology planning and accomplishments towards key technology goals; 3) demonstrate interdepartmental cooperation to successfully complete technology projects to meet institutional goals and the demands of a rapidly growing campus; and 4) provide insight into technology decisions and funding sources.

In August 2020, Colorado Mesa University's Board of Trustees approved the continuation of the *2020 Strategic Plan*—including the mission, values and vision statement—through the end of December 2021. It was determined that the current strategic plan continues to be an appropriate planning structure, and under the current unprecedented and uncertain conditions of COVID-19, it is advantageous to continue to work from this planning document until the conditions of the pandemic are clearer.

The Board of Trustees approved the *2020 Strategic Plan* on January 29, 2016. The *Technology Master Plan* has been historically updated every four years. The development of 2020 *Technology Master Plan* follows the decisions to extend the 2020 *Strategic Plan*.

A History of Technology Planning at Colorado Mesa

Colorado Mesa University's first *Technology Master Plan* was completed January 19, 1999 and was submitted with the *Facilities Master Plan*, as found in Volume II, Appendix G. The history of technology development at Mesa State College from 1985 to 1999 is summarized in Appendix A of the 1999 *Technology Master Plan*.

The 1999 *Technology Master Plan* was amended in 2002 following the completion of the 2001 *Academic Master Plan*, and was submitted and reviewed concurrently as part of the *Facilities Master Plan Amendment.* Major technology accomplishments at this time were credited to the 1999 *Technology Infrastructure Program Plan* projects funded by the State. In addition, the 2002 *Technology Master Plan Amendment* provided information required by the Colorado Commission on Higher Education (CCHE) Policy as outlined in Section III: Capital Assets, Part D. Guidelines for Long Range Facilities/Infrastructure Master Planning, as revised April 5, 2001. The 2002 plan outlined specific projects and funding requests to meet those requirements.

The *2007-2008 Technology Master Plan* aligned six major technology initiatives with the institutions strategic goals as outlined in *Achieving A Higher Degree: A Strategic Plan and Vision for Mesa State College.* Technology goals and projects that support each initiative were established and documented. The format of the *2007-2008 Technology Master Plan* was modified to document the wide range of technology projects that support the institution and their alignment to the institution's strategic goals.

The *2012 Technology Master Plan* was updated following a comprehensive review of the *2004 Strategic Plan* in 2010. The *2010 Strategic Plan* was approved by the then Mesa State College Board of Trustees on January 27, 2011. On August 10, 2011, Mesa State College officially became Colorado Mesa University. A number of technology goals were added with the *2012 Technology Master* Plan, and two of its technology initiatives were broadened to emphasize the need to expand business continuity planning and improve support for today's mobile learners.

The *2016 Technology Master Plan* was updated following the Board approval of the of the *2020 Strategic Plan* on January 29, 2016. Three overarching goals were established in the *2020 Strategic Plan* and metrics were aligned with each strategic goal/objective. Technology is an integral part in accomplishing each strategic goal, with metrics under Objective 1D directly tied to Information Technology support and the advancement of technology infrastructure.

Institutional Overview

The University's Role and Mission

Colorado Mesa University (CMU) provides a broad, liberal arts core for its wide range of programs in the arts, sciences, humanities, and selected professional disciplines. CMU serves approximately 10,500 students annually and has four campuses in Western Colorado: Main, South, and Bishop campuses are located in Grand Junction, and the Montrose campus is located in Montrose Colorado, approximately 60 miles southeast of Grand Junction.

Colorado Mesa University, as part of its community college mission, has a two-year division located primarily on the Bishop Campus – Western Colorado Community College (WCCC) – which offers career and technical education programming. The University's service region for delivering community college courses and programs is a subset of the 14-county area described below, while delivery of vocational courses is limited to Mesa County. Colorado Revised Statute (C.R.S.) 23-53-101 defines CMU's four- and two-year role and mission.

Responsibilities as a Regional Education Provider

CMU's service region, defined by the Department of Higher Education, encompasses a 14-county area in Western Colorado. This 14-county area – Mesa, Montrose, Delta, Ouray, San Miguel, Garfield, Pitkin, Eagle, Summit, Moffat, Rio Blanco, Routt, Jackson, and Grand counties – covers more than 28,000 square miles. Within this region there are numerous rural communities, which are isolated geographically by distance and terrain. CMU's responsibilities as western Colorado's regional education provider are defined statutorily in C.R.S. 23-1-127 (b):

>"As regional education providers, Adams state university, Colorado Mesa University, and Western State College of Colorado shall have as their primary goal the assessment of regional education needs and, in consultation with the Colorado commission on higher education, the allocation of resources for the purposes of meeting those needs."

The University delivers programs locally and regionally through a combination of site-based and distance delivery modes at a range of times and locations as part of its evolving role as a Regional Education Provider.

Partnerships have been formed with other community colleges in the region, as well as with Western Colorado Community College, not only for degree completion tracks but remote sites for the delivery of distance education courses.

State Performance Funding

State fiscal support for the University continues decline. Additionally, the State adopted a new performance funding model for the FY 2015-16 budget as specified in HB 14-1319. With HB 14-1319, the State emphasized transparency in higher education funding and key outcomes (e.g., timely graduation rates) and reflected a strong desire to make the funding formula more understandable to Colorado taxpayers, students and families.

Institutional Strategic Planning Goals for 2020

The *2020 Strategic Plan* was approved by the Colorado Mesa University Board of Trustees on January 29, 2016, and extended in August 2020 through the end of December 2021. The University's current strategic planning goals and objectives are as follows:

Goal 1. Become the university of choice for students, faculty and staff with a focus on academic excellence.

Objective 1A. Become the university of choice for students.
> Strategy 1. Attract and retain students with increasing levels of academic preparation.
> Strategy 2. Offer a rigorous student-centered educational environment that promotes academic success.

Objective 1B: Attract and retain faculty who balance a passion for teaching with a commitment to scholarship.

Objective 1C: Attract and retain staff who embrace the institution's student-centered focus and are committed to student success.

Objective 1D: Advance learning opportunities that are innovative, integrated, experiential, and interdisciplinary.

Objective 1E: Increase recruitment and retention of faculty, staff, and students who reflect geographical, racial, ethnic, and age diversity.

Goal 2.   Increase the level of educational attainment in the region through quality academic programming.

Objective 2A: Boost new student enrollment by an average of 2% per year.

Objective 2B: Increase the rates of first-year retention and six-year graduation for all students while reducing the attainment gap.

Objective 2C: Selectively add programs that enhance student opportunities after graduation.

Objective 2D: Increase community awareness of, and participation in, the life of our campus.

Objective 2E: Ensure that all graduates are prepared with the knowledge and skills required for the success in the 21st century workplace.

Goal 3. Continue the maturation of the university at all of its campuses.

Objective 3A: Continue commitment to small class sizes that promote high levels of faculty-student interaction.

Objective 3B: Nurture faculty members who embrace CMU's teacher-scholar model.

Objective 3C: Continue to strengthen financial and Organizational structures that support the University's strategic goals.
     Strategy 1. Ensure student-centric business process and data-driven institutional decision making.
     Strategy 2. Set Budget priorities in alignment with strategic planning goals.

Objective 3D: Enhance awareness among present and potential students of the educational opportunities available through CMU's WCCC division and the Montrose campus.

In addition, metrics were aligned with each strategic goal/objective. Arguably, technology will play an integral part in accomplishing each strategic goal, although metrics under Objective 1D are directly tied to Information Technology support and the advancement of technology infrastructure: expanded use of digital content and services (e.g., use of materials available from lecture capture; number of student e-Portfolios) and increased connectivity (e.g. amount of wireless infrastructure and bandwidth).

An Overview of Information Technology at Colorado Mesa University

Information Technology Mission

Information Technology serves Colorado Mesa University by strategically deploying technology, enabling the institution to achieve its goals and role as defined by the state as a regional education provider. With dedicated professional support staff, the Information Technology staff provides innovative teaching and learning environments, reliable and secure administrative systems, and access to electronic information to assist a diverse community of students and faculty.

Information Technology Department

The University's technology resources are centrally managed and supported by the Information Technology (IT) department. The centralized management of IT systems and services is in part why the University continues to maintain lower operating budgets and is, in general, more conducive to securing information and streamlining technology implementations. Core IT systems and services are supported entirely by personnel located on the main campus. Computer support and help desk services are mainly provided from the main campus with the aid of student workers with the exception of a technician located at the Bishop campus.

The Information Technology department is comprised of four units and twenty-seven (27) full-time equivalent (FTE), which work closely to meet the goals of the department and University. The Vice President for Information Technology reports to the President. Help Desk support services are integrated into the responsibilities of positions in each unit.

The four IT units by area of responsibility are:
- Information Systems (6 FTE) is responsible for the University's administrative and student information system, Banner, which includes faculty/staff and student web-based self-services, supports enterprise financial services (payroll, general accounting, accounts receivable, and accounts payable), budgeting services, human resource services, and student services (recruitment, registration, advising, and financial aid) as well other enterprise software including one card systems. This unit also assists with the evaluation of new software, and maintains interfaces between business applications and develops custom reports.

- Computing and Network Systems (6 FTE) manages a robust and secure data network and the core computing services for the University, including firewall, E-mail, data storage and backup, and server support. This unit works closely with the Telecommunications and Instructional Technology unit to provide local area, wide area, and wireless network access for students, faculty, and staff. This entire unit actively participates in providing Help Desk support including all tier-2 and 3 support functions. The Director for Computing and Network Systems job responsibilities include managing security audits, vulnerability and threat

assessments and direct responses to systems and network security events in addition to implementing information security policies and procedures and information security awareness programs.

- Computer Support Services (7 FTE) is responsible for installing and maintaining office, classroom and lab desktop computers and workstations; administering the University's computer refresh program; software distribution; and maintaining software licensing records. The core of the Help Desk is comprised of staff from this work unit.

- Telecommunications and Instructional Technology (7 FTE) is responsible for the telephone system and telecommunication services, operator services, video conferencing, building structured cabling and infrastructure, and audiovisual (AV) support for classrooms and events.

The University contracts with Ellucian Application Managed Services (AMS) to provide Oracle and MS SQL Server database administration (DBA), plus software maintenance services for all licensed Ellucian software and the third-party software platforms on which they run. The University outsourced its DBA work in fall 2015 after its longtime administrator retired. Ellucian Banner, CMU's student information system, and other enterprise applications utilized across the institution are critical to the mission of the University

Information Technology Funding

Information Technology is responsible for overseeing campus-wide technology budgets and projects, and through rigorous purchasing processes, has set campus standards for most hardware. IT operational funding is at an all-time high for the institution, although the staff funding level would still be considered lean by most campus standards. The University's Technology Sustainability Plan is currently funded at $1.6M.

Technology Trends

The information age has evolved to the age of experiences. Mobile device use is ubiquitous among college attendees, with traditional age students having access to smartphones since they could walk. Students with mobile devices with native features such as video cameras, anytime access to the internet, collaboration and social media applications, and online gaming have evolved the information age to the age of experiences. Students continuously engage in these digital experiences, and they will look for quality digital experiences at college as well.

The major technology trends covered in the *2016 Technology Master Plan* are still relevant today: 1) bring your own device, 2) cloud services, 3) innovative learning environments, and 4) customer relationship management and business analytics. These trends are the basis for the new trends described below and are foundational to moving

through the age of experiences. The number of Bring Your Own Devices (BYOD) that students and employees connect to the wireless network continues to increase with the expansion of consumer IoT devices on the market. The digital experience, and the explosion of interactive apps and video, are increasing demands on wireless networks and bandwidth requirements. The expansion and capacity of cellular and WiFi networks must advance to keep pace with consumer demands, and advancing the University's network infrastructure continues to be priority to successfully support the student digital experience and academics. Information Technology will continue to deploy the latest WiFi standards to support higher wireless data speeds in high density areas such as large academic building and residence halls.

Network reliability and security must meet the highest standards as cloud services are now more prevalent than enterprise software installed on-premise. Where the institution's computing and data storage infrastructure is located is no longer a primary decision point as the University frequently adopts new cloud-service providers. A standardized process to vet software-as-a-service (SaaS) delivered solutions has now overcome the uncertainty of moving to the cloud due to security, reliability and change management concerns. However, there is always a need to improve the SaaS selection process to protect institutional data and advance the University's data integration strategies. Information security continues to be a top priority for the University.

The University will continue to develop innovative and advanced learning environments that promote student collaboration and increase student-faculty interactions. The University subscribes to a number of online applications that support collaboration and the digital experience including Zoom, Microsoft Teams, Panopto, and e-Portfolios to name a few. In addition, a number of new experiential learning spaces have been established in recent years including the Maverick Innovation Center, the Health Sciences Center simulation lab, and the new Lineworker facility. With the rate at which technology is advancing for the consumer, and the rate it can be applied to learning and the enterprise, the only limitations on learning environments will be institutional resources to implement the supporting infrastructure, and the demand on instructors to learn and incorporate these new technologies into their curriculum.

The University has increased the use of its Customer Relationship Management (CRM) solutions with advancements in the areas of recruitment and student success initiatives. The University continues to improve its operational efficiency while maintaining its personalized approach to working with students as they enroll and progress to graduation. CRM applications automate business processes to help engage students, manage data, and measure recruitment and retention efforts, as well as improve communication channels. In addition, the University continues to use analytics through business intelligence report writing software to improve institutional knowledge and support data-driven business decisions. The use of analytics software has been supported with the addition of new metrics to help understand how students use facilities and engage across campus.

The remainder of this section summarizes key technology trends that the University will need to continue to advance as strategic decisions are made over the next three to five years.

Digital Transformation

The University has implemented numerous applications to improve the student experience and gain administrative efficiencies. These improvements helped keep pace with student expectations and employee demands for consumer-like solutions from the enterprise that are accessible anywhere at any time. Over the past few years, the University has made significant investments in projects like revitalizing MAVzone, advancing CRM technologies for recruitment and student success, deploying applicant tracking software for employee recruitment, and implementing e-forms and workflows. However, a complete digital transformation is more than eliminating paper forms and streamlining business processes. It's adopting strategic technologies and a new philosophy that can change how the institution is perceived by its customers and identifies new business models.[1] [2]

At the core of digital transformation in higher education is the student experience.[3] It is important to create an experience—academic and administrative—that is seamless for the student regardless if the services are delivered online or in person, support is available by machine or staff, or the learning environment is offered virtual or traditional. Digital transformation is not one technology project or process-improvement initiative; it is a comprehensive change that focuses on the end user and going about business differently. Technologies that enable digital transformation include, but are not limited to: mobile, cloud, IoT, predictive analytics, and artificial intelligence. Projects that can transform the institution's digital presence include:

- Modernizing the Enterprise Resource Planning (ERP) solution. This project will include mobile and an enhanced user experience, cloud computing, and a well-defined data integration strategy. Adopting a more modular approach to ERP systems will enable the University to be more agile and change quickly to meet customer needs.
- Augmenting service operations to provide seamless, personalized support in person and online alike. Supporting projects will include enhancing self-service options through intelligent agents and conversational language technologies, and provide mobile apps to help students and employees complete tasks.

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[1] D. Christopher Brooks and Mark McCormack. *Driving Digital Transformation in Higher Education.* ECAR research report. Louisville, CO: ECAR, June 2020.

[2] Malcolm Brown, Betsy Reinitz and Karen Wetzel, "*Digital Transformation Signals: Is Your Institution on the Journey?*" EDUCAUSE Review, Enterprise Connections Blog, May 12, 2020. "Digital transformation is a deep and coordinated culture, workforce, and technology shift that enables new educational and operating models and transform an institution's operations, strategic direction, and value proposition."

[3] D. Christopher Brooks and Mark McCormack. *Driving Digital Transformation in Higher Education.* ECAR research report. Louisville, CO: ECAR, June 2020. "Six of the top seven major benefits of Dx that respondents identified are directly focused on student success."

- Automating business processes to improve operational efficiencies, reduce data errors, and improve communication streams. Projects under business process automation include the continual improvement of CRM applications, digitalization of employee onboarding, and development of advanced workflows.
- Adopting collaborative workspaces to advance communication practices may also be included in the digital transformation. Projects that change how we use everyday tools to interact with student and colleagues is part of the transformation process. The combination of cloud storage and productivity applications, web conferencing tools and persistent chat are a move to a more collaborative and interactive university community.

Immersive Learning Environments

In their personal lives, students are surrounded by digital experiences and not just static images and content. These digital experiences are in part due to smartphones, social media and video games; and, in many ways, business and education adopt technology developed for the individual consumer's everyday experiences. For example, today's students were introduced to online gaming with social interactions and communicating with friends in middle school, or even consumer-grade virtual reality headsets for entertainment. These technologies continue to develop in higher education. Virtual reality applications can be readily subscribed to for professional training, and the idea of gamifying learning materials in education has been around for years. Students are used to these types of digital experiences and technologies at home and will become increasingly comfortable with their use in college coursework.

The University already provides many experiential learning opportunities including science labs, medical simulation labs, internships, theatrical performances, and undergraduate research to list some examples. Similar to everyday experiences, learning will be pushed from current forms of digital content and specialized labs to immersive experiences that can be accessed from almost anywhere and with minimal equipment. Moving forward, immersive learning opportunities will be driven by Extended Reality (XR) technologies such as virtual reality, augmented reality, and mixed reality—where virtual and real worlds interact. These opportunities will advance online STEM labs, hands-on professional training and skills labs, and perhaps even social learning activities. XR technologies will allow difficult, or even dangerous, situations to be repeatable, engineering tasks to develop at a much faster rate, and allow ideas to come to life.

Internet of Behaviors

Student engagement has proven in recent years to be one of the most critical factors in student success. Implementing infrastructure to support IoT and BYOD devices and systems that collect data is making way for better analytics and the idea of the Internet of Behaviors (IoB) in higher education. IoB is using the digital information available to influence behaviors. Over the past four years, advancements in campus infrastructure—networking and wireless device onboarding—to provide the necessary connectivity to

leverage cloud-based services, has led to a network of access points that can be used to not only help determine how many attend an event but the duration of time a facility was used. Historically, the University collects card swipes at events and student activities, uses online surveys, and leverages student service office applications to try and understand how students engage across campus. The data was often siloed and did not reflect the behaviors of the entire student body. In 2018, the University began measuring student engagement by leveraging its wireless infrastructure.

Moving forward the University will need to continue to expand information systems and infrastructure that ensure academic and behavior metrics collected will better inform teaching and learning, extracurricular activities, and resource planning. The use of technologies to proactively identify students in need and provide them support will require these metrics to be operationalized to improve student success. At this scale, the use of intelligent agents to proactively inform students of potential next steps or opportunities will need to be developed. Artificial intelligent (AI) chatbots for online help are used today, but this is just the beginning. As AI technologies continue to develop for higher education, intelligent agents, for example, will become a larger part of e-learning systems and recommend useful learning materials and support opportunities. As IoB and related technologies develop, information security and privacy must be at the forefront of adoption discussions.

Pandemic Response/Disruption

Moving classes fully online at the onset of the pandemic last spring and hybridizing courses for fall 2020 was a significant challenge. Students attending remotely due to being placed in isolation, not being able to travel to campus or just not being comfortable attending in person placed a strain on campus technology systems, financial resources and human capital. The changes made to accommodate remote learning were because of a global pandemic, but providing students the flexibility to move in and out of face-to-face instruction may be one of the biggest disrupters in education moving forward. Flexible learning modalities on a weekly or session basis to provide proper social distancing or de-densifying campuses and classrooms, or simply for convenience, may become a new norm in higher education.

Course delivery options made available to students due to the pandemic will change the campus landscape moving forward if not accelerate the need to adopt flexible courses models to meet student requests and University requirements. Decisions regarding higher education business models and expanding course delivery offerings must involve faculty to ensure the approach(es) selected are pedagogically sound. Providing flexible course delivery options has limitations and will continue to initiate discussions regarding student access to technology, University resources, and student and faculty development in the use of digital platforms.

The pandemic brought old barriers to new heights. Access to technology challenges, whether due to living or work locations or the lack of financial resources, were exacerbated when the pandemic pushed students online and the workforce remote. These

challenges were evident by the numerous requests for laptops and connectivity options to allow academic and administrative work from home, and the number of reports of student and/or employees without adequate or reliable broadband at home. Access to and feasibility of broadband in rural communities continues to be an important topic of concern, but one the institution by itself will not be able to solve. However, the institution can reevaluate its approach to remote learning and teleworking which will more than likely require higher cost options than providing economical, on-campus solutions. Student and faculty laptop requirements as well as virtual labs required a fresh look as the computing landscape shifted from traditional site-based options to remote, mobile computing requirements.

Further, the consumerization of educational and administrative systems will be pushed forward at greater rates of change. A strategy for automating service tasks and enabling self-service help options will need to accelerate. Although the institution spent significant resources on student and faculty support and training on learning management, lecture capture, web conferencing, and remote proctoring applications, there is a need for additional professional development and student training initiatives.

Technology Initiatives

The Technology Master Plan identifies major technology initiatives, aligning them with the institution's strategic goals, and summarizes key technology advancements towards those goals. The following list of technology initiatives and goals is not intended to be a complete list of IT projects completed, planned, or in process. Information Technology has identified six major technology initiatives that serve as the organizational structure for the following section on IT goals and accomplishments:

1) Improve business processes and institutional decision making through the use of technology;
2) Advance information security programs and business continuity planning;
3) Expand the digitization of content and services in support of the 21st century teacher/learner;
4) Improve access to online services regardless of physical locations and time of day;
5) Efficiently manage university resources; and
6) Advance campus technology in support of institutional initiatives and campus expansion projects.

Information Technology Initiatives, Goals, and Accomplishments

Note: A majority of the *2016 Technology Master Plan* initiatives and goals have remained the same to reflect the continuation of the institution-wide goals of the *2020 Strategic Plan* and today's technology trends. Where applicable, progress updates to the

2016 Technology Maser Plan have been added to the end of the goal to either update or provide a closeout statement for the previous 2016 goal.

Initiative 1: Improve business processes and institutional decision making through the use of technology.

Goal 1A: Improve business analytics, reporting and practices to support management decision-making processes.

Alignment: Institutional Goal 3, Objective (O)3C-Strategy (S)1

Status: In-progress

Accomplishments:

In 2016, the University began implementing Ellucian Operation Data Store (ODS) and IBM Cognos Business Intelligence Reporting software to improve institutional reporting and support data-driven business decisions. This reporting and business analytics solution enables business areas to create reports and perform analysis on Banner—Registration, Employee, Faculty Assignment, Payroll, Student, and Financial Aid—reporting views while improving data security through fine-grained access control polices for ODS data with security groups and access security on report folders. ODS improves the integrity of transactional reporting for the institution and helps ensure data is consistently used across departments. ODS converts Banner data structures into common business terms that department can select for Cognos reports. Cognos delivers operational reports and dashboards. This self-service reporting tool empowers departments to make better use of their data and support institutional data-driven decision processes. Cognos auditing provides a log of users and the reports they are running as an additional data security control. By 2019, all reports previously developed reports through Crystal Reports were converted to Cognos.

The University continues to look for metrics to assist the development of programs and improve student retention rates. In 2018, CMU contracted with Degree Analytics to analyze how students engage across all its campuses. Degree Analytics takes unstructured wireless logs and provides the university student attendance and behavioral metrics to enhance early alert and student success programs. For example, the Degree Analytics program provides student attendance metrics earlier in the semester and at a higher frequency than the existing academic early alert feedback system. Metrics such as accumulated attendance scores, course attendance scores, and course attendance weekly absence information is imported into CRM Advise as well as returning weekly behavioral metrics files for Institutional Research. Student attendance nudges have been piloted using the attendance metrics, and work continues on operationalizing the programs data points.

Goal 1B: Implement web-based administrative platforms and modernize the University's Enterprise Resource Planning (ERP) systems to improve services.

Alignment: Institutional Goal 3, (O3C-S1)

Status: Ongoing

Accomplishments:

A number of advancements in administrative systems have been made since 2016. These efforts focused on the user experience, automating processes, and a mobile-first approach. Two of the largest projects accomplished over the last four years include a revamp of the University's web portal, MAVzone, and upgrading Enterprise Resource Planning (ERP), Banner, Self-Service applications. These two projects were interdependent since student account information and improving the navigation of Banner Self-Service forms were a focus of the new portal design.

In February of 2017, student focus groups were conducted to ascertain what students understand about MAVzone and their sentiments regarding the current web portal. At that time, students characterized MAVzone as too busy and full of text making it difficult to find information. It was also noted that students often use the MAVzone login page to access applications; less than twenty-percent of the time that students logged in they were accessing the portal platform, Luminis, in order to access Banner channels. However, it was found that students overwhelmingly had positive comments about the Student Academic Links in Luminis to access Banner Self-Service channels for tasks such as completing timecards and locating student finance information.

The University launched a completely revamped MAVzone web portal for fall 2018. The new MAVzone was developed in-house to be mobile friendly and designed to perform single sign-on to third-party applications such as D2L and O365. To make it easy to find apps, users can tag favorite apps or use the search feature under Applications. MAVzone content is still based on Banner user roles—student, faculty and staff—but MAVzone was developed to be more personalized; the MAVzone My Account page provides information such as student and employee, advisors, and course information. A significant amount of time was spent on the development of a personalized My Tasks list for students. Banner data is used to add and remove required tasks based on an individual's account information in near real-time. As an example, a student required to live on campus would be presented with a task to Apply for Housing when housing assignments were available for selection. It should be noted that while developing MAVzone, the now current Banner 9 Self-Service applications were not yet available which influenced several decisions on how to present Banner information until the new, and highly anticipated, Banner 9 Self-Service apps were ready.

In 2019, CMU completed its upgrade to Banner 9 Self-Service. This multi-year project required a tremendous amount of IT resources, coordination with Ellucian Application Managed Services, and department collaboration and testing. Information Technology and administrative departments have release Banner 9 Registration, Student Profile, Financial Aid, and Employee Profile for faculty and staff. These Self-Service apps are now live and accessible through MAVzone; for example, the Banner 9 Employee Dashboard replaced the Employee Quick Links in MAVzone. The University will continue to go live with more Banner 9 Self Service applications as departments complete their testing procedures. The Banner 9 Self Service application provides students a more modern, mobile responsive set of apps.

Further, an e-forms and workflow solution was purchased in 2019 to further digitizing processes that previously required paper or electronic (pdf) forms to be completed and submitted through email or in person. The e-forms app, available through MAVzone and website links, allows for Banner data fields to prepopulate, saving students time. The form completion process with workflows configured streamlines the submittal/approval process with forms accepted using the integration to Banner document management system to save and image indexes for forms.

Modernizing the University's Enterprise Resource Planning (ERP) and enterprise systems including the migration to cloud services continues to be a priority. In 2019, CMU engaged Ellucian to evaluate the overall use of Ellucian solutions licensed, including Banner ERP—Finance and Student Information Systems—to identify opportunities to improve the return on its technology investments. The process to align technology purchases and improvements moving forward with strategic initiatives and the development of a timeline for implementing recommendations began in late spring; included on-campus meetings with executive team members and subject matter experts from both the institution and Ellucian over the summer; and culminated early fall in a Strategic Alignment Plan. The process helped department users understand the full breadth of the solution features and capabilities to strengthen operations and improve the user experience. Several recommendations were derived and presented in the final reports such as adopting baseline Banner first to remove unnecessary maintenance burdens; using more CRM Advise capabilities like case management and the student portal; using Banner Communication Manager to streamline student communications; and implementing the Ethos Platform Data Model for sharing data between Banner 9 and third-party software. The University continues to work on its digital transformation through advancements in its core administrative systems.

2016 goal update: The 2016 goal was broadened to not only address student access to administrative and academic support services but include the modernization of the University's ERP system in the 2020 plan.

Goal 1C: Manage and automate student-centric processes through the development of Customer Relationship Management (CRM) technologies.

Alignment: Institutional Goal 1, (O1A-S1 & 2, O1E); Goal 2, (O2A, O2B); and Goal 3, (O3C-S1)

Status: Ongoing

Accomplishments:

The University continues to enhance its Customer Relationship Management (CRM) solutions. CRM Recruit for Admissions and CRM Advise for student success went live in 2014 and 2015, respectively.

Since going live with CRM Advise for the Office of Student Success in fall 2016, strides have been made in the use of CRM Advise for the Office of Student Success, Integrated Resources for Information and Solutions (IRIS), and faculty advisors. CRM Advise was developed to aid in the improvement of student retention by:
- providing a holistic view of each student that combines academic, cognitive, and non-cognitive student data from disparate data sources;
- identifying students at risk of not persisting in their education to a degree through scoring plans;
- improving communication with students that is relevant, timely and personal; and
- providing insights into the effectiveness of student success programs.

Early adoption of the student success solution was in the Office of Student Success, and by spring 2019, training on the product was provided to faculty advisors in all departments. Faculty training on the use of CRM Advise is comprised of introductory and hands-on sessions for managing student Early Alert communications. A Faculty Advisor Report Dashboard is provided to assist faculty advisors in the review of 4- and 7-week Early Alert reports as well as information on their newly assigned advisees and advisees not registered for the next term. A full description of the development and implementation of Ellucian CRM Advise can be found in the Working Group to Improve Student Academic Success May 31, 2017 report, *Enhancing Student Engagement: Proposed Recommendations to Improve Student Success*. Further, CRM Advise was configured to use Twilio for SMS messaging for student outreach in 2018, with Twilio phone numbers provided to IRIS staff.

Likewise, over the last four years, several upgrades to the CRM Recruit platform have been performed. CRM Recruit enhancements developed to date include adding Twilio accounts for Admissions counselors and configuring CRM Recruit to allow sending text messages to students individually and to populations of students; installing a second web front end to accommodate a separately branded

WCCC admissions application; and moving orientation registration from Banner Self-Service to CRM Recruit Events.

Goal 1D: Expand the use of Human Resource Management Systems.

Alignment: Institutional Goal 1, (O1B, O1C, O1E)

Status: Ongoing

Accomplishments:

In 2016, the University selected a Recruitment Management and Applicant Tracking solution with a focus on the applicant experience. The applicant tracking system, Cornerstone OnDemand, has improved customer service and automated business processes and ultimately has made CMU more attractive to candidates. The system, for example, has improved communication with candidates throughout the search process and has increased candidate pool retention by reducing the time from posting to hire. The applicant tracking system has allowed the University to broaden its exposure to national career sites and increased diversity within applicant pools.

Since going live with Cornerstone OnDemand, additional steps in the hiring process have been automated. First, the required Banner 9 modules, including Position Description, were installed to support the integration between the applicant tracking system and Banner HR. Then, a custom integration was implemented to transfer new hire data between the two applications and create employee person and job records in Banner.

To further streamline business processes, the Banner Faculty Load and Compensation module was fully developed to automatically calculate compensation for full-time faculty overload assignments and adjunct faculty assignments. Implementing the Faculty Load and Compensation module improved reporting through integrations with Banner HR and Banner Student modules which allows CMU to more accurately calculate the cost for teaching a course.

Moving forward, Human Resources and Information Technology will focus on improvements to the employee on-boarding process and digitizing the final paper-based processes into online solutions.

Initiative 2: Advance information security programs and business continuity planning.

Goal 2A: Expand information security awareness programs.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

The University continues to educate student and employees on cyber threats and their personal financial risks and how individual actions can put the University at risk of a cyber incident such as a ransomware attack. In addition to computers and wireless clients connected to the network, users are the largest cyber threat attack surface to the University. For this reason, an active information security awareness program continues to be an essential component to combating cyber threats, and the University has taken several steps since the last *Technology Master Plan* update to improve the program and put in place additional information security controls to protect the privacy of students, prevent the loss of data, and control access to the network and computing systems.

Information Technology staff collaborate with other institutions on the Colorado State Higher Education Information Security Forum, and receive insights and resources from national organization such as Multistate Information Security (MS-ISAC) and SANS. Improvements to the information security program include, but are not limited to, updating the University's information security topics and resources website, and improving the outreach of information security for students using social media.

Social engineering attacks in the form of phishing emails are the most prominent ransomware attack vector. No matter which cyber incident report you read, the disturbing reality is cyber incidents and data breaches are on the rise. The majority of malware is delivered via email, and phishing accounts for more than 80% of social engineering attacks.[4] Therefore, improving student and employee awareness of phishing emails and social engineering techniques has been a high priority over the last four years. Moreover, ransomware accounts for 27% of malware incidents[5], and a recent ransomware attack in higher education in the State is evidence of just how significant an attack can disrupt university operations and cause financial loss. In addition to information campaigns, Information Technology distributes small items with information security tips printed on them. As an example, "Phishing Tips" mousepads were placed throughout academic spaces such as the library, computer labs and offices.   The mousepads were printed with information security tips regarding how to identify and avoid phishing emails. Further, in order to assist users in the identification of potentially malicious email, external messages addressed to the CMU email system are flagged with a message indicating the email originated outside the organization to heighten awareness to the potential of malware.

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[4] Verizon 2020 Data Breach Investigations Report, phishing accounts for over 80% of the social engineering attacks
[5] Verizon 2020 Data Breach Investigations Report, ransomware now accounts for 27% of malware incidents

Another security awareness technique in use is sending fake phishing email tests using convincing messaging to train users to avoid clicking on suspicious links. The fake emails are followed up with educational materials. The purpose of this technique is to enhance the end user's recognition of malicious emails. Additional security measures have also been implemented. The University configured multifactor authentication to help protect students, staff and faculty from phishing attempts and scams designed to obtain their personal information or login credentials. Signing up to use the multifactor authentication is currently optional. The university is discussing making multifactor authentication mandatory for both students and employees.

Goal 2B: Update Information Technology policies and security practices with a focus on addressing risks associated with mobile devices and cloud services.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

A number of information security policies and practices have been implemented since the last *Technology Master Plan* update to address the risks associated with 1) the prevalent use of cloud service providers and storing university data off-premise and on cloud service provider systems, and 2) the increasing number of mobile devices used by university constituents to access sensitive or confidential information.

The University has established contract management protocols for reviewing the contractual obligations of cloud service providers to ensure they have the necessary data protections and technological safeguards in place to protect institutional data. The university has little to no control over how university data will be protected once it is transferred to a cloud service. One way the University addresses the risks associated with cloud services is contractually and fully vetting the administrative and technical controls that the service provider agrees to use to protect the university's data. CMU does not allow a cloud service providers access to University data without the appropriate, agreed upon contractual language to establish data confidentiality and data privacy requirements, compliance with currently recognized data security standards, and protocols for notifying the University in the event of a data breach.

Another preventative measure the University has established to protect institution data to be transferred and stored with cloud service providers is employee awareness through a *Data Protection Plan* adopted in 2017. The *Data Protection Plan* establishes data protection principles which are communicated to campus data stewards to assist with evaluating service provider contracts and products to ensure the minimum necessary protections for institutional data will be provided

and to limit the exposure of confidential information to the minimum necessary required for the intended use of the application. It is the responsibility of university employees to help secure campus data. They are the front-line defense to information shared with cloud service provider, and the University relies on all employees to understand the importance and know how to protect the data entrusted to the institution.

The University maintains mobile device management controls, protocols and procedures that ensure necessary technological safeguards are in place to protect institutional data that may be stored, processed or accessed on or through mobile devices based on data protection levels outlined in the *Data Protection Plan*. Mobile devices represent a significant risk to information security, as they can be a conduit for unauthorized access to the university's data and IT infrastructure if the appropriate security applications and procedures are not applied. This can subsequently lead to data leakage and system infection. Special consideration shall be given to remote access to information systems and the establishment of usage restrictions and configuration requirements from mobile devices

To protect sensitive information accessed through mobile devices, Information Technology has implemented multifactor authentication to protect the faculty, staff and students from phishing attempts and scams designed to obtain their personal information or login credentials. In 2020, social engineering in the form of phishing attempts make up over 80% of the cyber-attacks today.[6] Users access multiple applications including email through their mobile devices. Signing up to use the multifactor authentication is currently optional. The university is discussing making multifactor authentication mandatory for both students and employees.

In 2018, CMU upgraded the its Network Security Appliances, or firewalls. The firewalls have Intrusion Prevention System capabilities to actively block known harmful packets and assist in preventing cyber-attacks and provide Virtual Private Network services among other security features. Network traffic passing through the network security appliances are examined for specific characteristics that may indicate the presence of malicious content capable of being downloaded to computers and mobile devices. Threat signatures or characteristics are updated on the firewalls multiple times to curtail zero-day attacks.

The firewalls actively prevent traffic destined for known command and control servers which are used to propagate various types of malicious attacks including ransomware and distributed denial of service attacks using botnet services or "zombies". Botnets are often infected with malicious software and communications technology used to coordinate the spread of malware or in some cases organize the illegal gathering of sensitive information. By utilizing the

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[6] Verizon 2020 Data Breach Investigations Report, phishing accounts for over 80% of the social engineering attacks

firewall's ability to block this type of traffic, the University is preventing the circulation of harmful packets to external organizations and individuals.

The FortiNet VPN client protects data in transit by encrypting information and sending it through a virtual private tunnel or pipeline. This prevents cyber criminals from easily intercepting packets of information that would otherwise be in an easily readable format. Therefore, any communication or data that is transferred through the VPN is private. This may include confidential institutional data stored with a cloud service provider, or personally identifiable information shared through applications/apps on mobile devices such as smartphones, tablets and laptops.

Goal 2C: Expand business continuity and disaster recovery planning preparations and testing.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

CMU has completed several projects to improve its business continuity and disaster recovery preparedness. The projects range from improvements to backup systems and alternate sites/server room locations to implementing redundant systems. The following projects demonstrate how the University has made advancements towards this goal over the last four years.

Safeguarding institutional data against inadvertent loss in the event of unexpected equipment failure, application error, human error or malicious attack, such as a ransomware, is critical to a robust business continuity and disaster recovery plan. Several improvements to the institutions backup systems have been implemented since the last *Technology Master Plan* update.

In 2019, a significant change was made to the University's backup systems. The Commvault data backup environment was moved out of the Active Directory network domain and moved into its own network workgroup to improve the institution's security stance against cyber threats including ransomware. By separating the Commvault central management server, media agents and target disks from Active Directory, critical data backup repositories were isolated from all other network-attached servers and clients, further reducing the risk of a network account being compromised and cyber criminals gaining unauthorized access to data backups. This precautionary step was taken in addition to leveraging Commvault's inherent ransomware protection features and using separate administrative credentials to access backups.

To improve site availability and uptime of information systems supported on-premise, the University operates an active alternate site to the main data center. In 2017, the University's alternate site was greatly improved with the completion of the Health Sciences Center (HSC) and the construction of a secondary server room. HSC was constructed on the site of a vacated hospital, and the hospital's server room was remodeled to provide a redundant alternate site with a backup diesel generator power, an uninterruptable power supply, and a redundant cooling system to ensure equipment uptime. New server enclosures were installed, and equipment, servers and storage were migrated from the former alternate site in Lowell Heiny Hall that had inadequate redundant power and cooling systems and very limited space. Further, the HSC alternate site is farther away from the primary data center in Wubben Science to help protect the institution in the event of large campus or natural disaster. The HSC server room houses all necessary network and server equipment for business continuity and disaster recovery planning and is the entrance facility for the secondary internet service provider.

In addition to the new alternate site, several information system replacement projects were successfully completed. The primary storage for the University, its Storage Area Network was upgraded in 2018. The SAN is comprised of two storage arrays with a Fibre Channel meshed network to connect servers to the storage arrays. The SAN's second storage array is housed in the secondary server room. In 2019, several high-end VMware Host servers were replaced including those that support Banner applications. For Business Continuity/Disaster Recovery planning, the VMware Host servers were divided and installed in the primary datacenter and the HSC secondary server room. Last, in 2019, the Commvault backup disk storage arrays in the main data center as well as the offsite backup disk storage array at the Bishop campus were upgraded under the Technology Sustainability Plan. The offsite storage upgrade was significant due to the implementation of newer hardware technology to expand our backup strategy with logically-detached copies.

In late 2016, the University added a secondary internet service provider and a pair of redundant internet routers to improve network uptime and network fault tolerance (for more information see Goal 4E). In addition, since the last update to the *Technology Master Plan*, redundant firewalls were purchased and additional line cards were installed in the core switch. However, the network still has several single points of failure. Over the next couple of years, the University is looking to upgrade its large-scale modular core switch, add a redundant core switch in the secondary datacenter, and upgrade the network backbone between campus buildings to provide redundant links. As a result of a core network switch upgrade, the University would have fully redundant network connections to the Internet to support students, faculty and staff.

Last, System Impact Assessment and Business Continuity Questionnaires are periodically sent out to department managers with responsibility or oversight over computer systems containing sensitive information. The information collected in

the questionnaires is being used to improve operational plans and build reference material that will enable the Information Technology department to respond appropriately to significant events negatively affecting the information systems utilized on a daily basis by the University.

2016 goal update: The 2016 goal for expanding disaster recovery planning now includes the term business continuity for the 2020 plan.

Goal 2D: Improve the process for which the University identifies, assesses, and manages the risks associated with IT systems and projects.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

The University has developed a process for determining the risks associated with the purchase and deployment of technology solutions.   First, CMU has established two formal plans to address information security—Data Protection Plan and Information Security and Incident Response Plan—and to help assess the information security stance and associated risks with using a particular solution or vendor at the onset of technology projects. The plans establish data protection principles which are communicated to campus data stewards to assist with evaluating service provider contracts and products to ensure the minimum necessary protections for institutional data will be provided and to limit the exposure of confidential information to the minimum necessary required for the intended use of the application.

Second, a Project Scoping Document was developed in conjunction with the Data Protection Plan to proactively gathering information that is vital to the planning and execution of a newly submitted technology projects. Technology projects initiated outside of Purchasing, or a Request for Proposal, start with the requesting department filling out Information Technology's Project Scoping Document to gather important details such as compliance with State and Federal laws, contractual and licensing concerns, hardware and software needs, and data confidentiality. The information gathered in return is used to develop a more accurate project scope, budget and timeline. In addition to these benefits, Information Technology is able to perform appropriate risk assessments to proactively protect university information.

Last, the University maintains contract management protocols for reviewing and establishing agreement terms and conditions to ensure technology service providers have the necessary data protections and technological safeguards in place to protect institutional data. CMU Purchasing's process for procuring technology products and services requires Information Technology to review

contract terms and conditions to mitigate information security risks. During the contracting phase of technology projects involving the processing, transfer or storage of institutional data, service provider contract documents are assessed to determine the security stance of the vendor supplying the technology solution. A vendor is not provided or allowed to access University information without the appropriate, agreed upon contractual language to establish data confidentiality and data privacy requirements, compliance with currently recognized data security standards, and protocols for notifying the University in the event of a data breach.

Initiative 3: Expand the digitization of content and services in support of the 21st century teacher/learner.

Goal 3A: Support the growth of distance education and online programs.

Alignment: Institutional Goal 1, (O1D)

Status: Ongoing

Accomplishments:

Starting fall 2016, the University required all course sections to have a D2L course shell and be used by faculty. In addition to providing a consistent place for students to locate course materials, students desire to access grades in real time, the ability to track assignment due dates, and connect with their instructors through the learning management system. Several integrations have been deployed for supplementary learning tools that support remote learning such as Panopto and Digication, and most recently added Respondus. The use of D2L has continually increased; however, when the University was forced to go online during the pandemic this past spring, the use of D2L and associated tools increased exponentially.

To help entering students navigate D2L and be successful, online students are required to completed an orientation course. In 2017, the D2L orientation process for online students was updated to avoid unnecessary delays for the students to gain access to their courses. There is currently a nightly process that examines the status of students who need to pass their D2L orientation, and reminders are sent so they don't get dropped from a course. Distance Education and the instructor also receive these communications to help ensure students complete the requirements.

Likewise, online and hybrid course instructors must complete Online Teaching Essential with Distance Education. In addition, steps have been taken to reduce the administrative burden on the faculty. Information Technology developed a process utilizing MAVzone, D2L and Banner APIs to pull gradebook data from a

D2L course and allow instructors to submit to Banner without double entering student grades.

To support the necessary increase in online assessments when many courses moved online or had some portion of the course delivered remotely this fall, the institution deployed Respondus Lockdown Browser and Respondus Monitor for online test proctoring. When students are required to take online tests remotely, Lockdown Browser and Monitor promote academic integrity when used with other course design and assessment techniques available through D2L.

Goal 3B: Support the adoption of digital media in lectures and course materials and provide up-to-date digital media platforms.

Alignment: Institutional Goal 1, (O1D), Goal 2 (O2E)

Status: Ongoing

Accomplishments:

The University continues to expand the use of digital resources – software, online applications and services, and digital content—for enriching learning experiences for the digital natives that make up the majority of college students today. The use of media files, software applications, and online services are prevalent across site-based and online courses alike. However, the University can always improve the quality, interactivity, and accessibility of its digital resources.

Applications and online services that enable student collaboration and student-faculty interactions are commonplace today. The University subscribes to O365 that not only provides students access to email, productivity applications and cloud file storage, but now includes an online collaborative workspace and web conferencing for class projects. This year, Zoom was adopted as the University-wide web conferencing platform to assist remote learning and student connections with instructors and advisors for office hours or advising sessions.

The adoption of digital course materials has grown exponentially. In spring 2018, the Bookstore piloted its direct digital program for e-textbooks as a lower cost option for course materials and to ensure all student can have access to their course materials by the first day of class. Today, more than 375 courses have an e-textbooks option available through the direct digital program. The number of students who participate in the program has grown from 3,233 in fall 2018 to 9,835 in fall 2020. Further, the University is encouraging the use of Open Education Resources (OER) which are predominately delivered in a digital format. In addition, there are numerous digital resources available through the Library with 92 online database subscriptions and student access to over 281,000 e-books as well as providing more OER materials.

With respect to software, there has also been growth in the number of desktop applications deployed across campus classrooms and labs. In 2020, Information Technology recorded 268 academic software packages installed which is up 21% from 222 in fall 2016.

The University reported in the last *Technology Master Plan* the purchase of two online applications to assist faculty and students with creating and viewing of digital media, for example, submitting class projects and reviewing lectures. Needless to say, the use of both applications has increased during the pandemic with the requirements for remote learning. However, even before the pandemic both platforms were used heavily by several academic departments. First, the University continues to use the Panopto lecture capture and video content management platform for recording, storing and viewing lectures and student presentations. As an example, Panopto is used in Essential Learning courses, such as Speech, for student presentations for instructor and peer review in both in-person and online classes alike.

Panopto provides a digital repository for storing multimedia with an online editing tool and is also facilitating the long-term storage of Zoom sessions.

Second, Digication's ePortfolio solution was purchased to support the University's implementation of an Integrative Learning curriculum model and its Essential Learning courses, including Maverick Milestone capstone courses. Digication also provides students and faculty a place to upload, design and maintain an online portfolio of their academic and professional work. To date, eleven academic programs have specifically designed ePortfolio templates for their courses while many other faculty members use the platform independently, and the number of student ePortfolios created each term are on the rise.

Goal 3C: Provide technical training and support campus digital literacy programs.

Alignment: Institutional Goal 1, (O1D)

Status: Ongoing

Accomplishments:

Perhaps the biggest gain due to the pandemic was the need for faculty to further develop their skills and comfort level with the learning management system, D2L, and supplementary learning tools that support remote learning. Information Technology and Distance Education spent considerable resources working with the faculty on the use of the various academic software in the classroom and online. Distance Education's team of instructional designers put forth a tremendous effort to assist faculty with course development as the University went completely online in March 2020 due to the COVID-19 pandemic. They continued their training efforts throughout the summer preparing for the start of a hybridized fall term.

The instructional design team offered virtual sessions on D2L, Panopto lecture capture software, ZOOM and Teams for web conferencing, and Respondus Lockdown Browser and Monitor for online proctoring. Information Technology continues to support desktop software and training on classroom AV systems.

Initiative 4: Improve access to online services regardless of physical locations and time of day.

Goal 4A: Increase internet bandwidth.

Alignment: Institutional Goal 1, (O1D)

Status: Ongoing

Accomplishments:

The University continues to add internet bandwidth critical to the success of students and faculty inside and outside of the classroom and build service and infrastructure redundancy to provide the most reliable network feasible to deliver online services. Increased bandwidth requirements are driven by several factors including faster wireless devices supporting higher resolutions, larger media files and research data sets, and innovation in learning like virtual reality.

Since 2016, internet bandwidth supporting the University has increased by two and a half (2.5) times. The University currently subscribes to 5Gbps of internet bandwidth and has added a second internet service provider to improve network uptime. To support two internet service providers, firewall and core network switch upgrades were performed to support the higher data throughput speeds and dynamic routing protocol, Border Gateway Protocol (BGP), to multi-home the campus network.

Goal 4B: Expand campus wireless infrastructure and increase support for Bring Your Own Device (BYOD) and Internet of Things (IoT) trends.

Alignment: Institutional Goal 1, (O1D)

Status: Ongoing

Accomplishments:

To improve student access to online content and services, the University continues to invest in wireless infrastructure and improvements to device onboarding. As of fall 2020, CMU has deployed 1,039 wireless access points, blanketing residence halls and academic buildings. The number of access points is up from 850 in 2016 and is almost double the number of access points deployed in 2012. The

overwhelming majority of access points currently installed support 802.11ac and speeds up to 1.3 Gbps. Further, Information Technology has steadily added outdoor access points over the last several years to improve Wi-Fi coverage for outside areas where students sit and study and participate in campus activities. Following a pilot over the 2015-16 academic year, Information Technology determined that migrating to Aruba wireless infrastructure—access points, controllers and management software—would benefit students and employees. Benefits of the Aruba solution include performance, ease of management, and reduced support costs.   In 2016, the University started a project to upgrade its wireless local area network to Aruba Networks

The enterprise wireless network is rated by more than coverage and connections speeds. High performance wireless networks of today must also be secure, scalable, and reliable. For a university campus, the wireless network must also function in an environment with a high density of wireless devices (clients) [7] and support mobility or movement between access points or roaming. CMU migrated its wireless local area network to Aruba over three years, completing the project in 2018. The Aruba wireless solution provides many advantages. Aruba's Client Match technology improves user experience by helping clients make better connection decisions based on the client's wireless radios, connection strength and how many other clients are connected to the same access point. Aruba's Airwave management platform improved visibility of clients on the wireless network, the ability to push configurations and updates to access points simultaneously, and tools for troubleshooting network and client issues.

For fall 2019, CMU implemented Aruba ClearPass to improve the onboarding of personal clients onto the wireless network and simplify guest wireless access in the residence halls and across campus. Visitors now self-register their wireless devices and receive a passcode via text message to connect without a campus sponsor or pre-shared keys. The ClearPass student and employee portal enables users to onboard their consumer-grade network devices— such as Amazon Alexa, Google Home, and smart TVs—on the University enterprise network without sacrificing security. ClearPass' AirGroup functionality allows students to share personal, registered wireless devices such as game consoles, wireless printers and video streaming devices with roommates and friends. Last, configuring Aruba ClearPass to identify client types on the network and setting up network policies to manage devices and enforce access through Dynamic Port Segmentation was a significant task. Implementing ClearPass improved the student, faculty, staff and visitor experience and simplified network administration with a consistent security policy for wired and wireless devices through this one management platform.

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[7] Hewlett Packard Enterprise Development LP. *What is 802.11AX (Wi-Fi 6)? And why you need it.* Aruba 2018. "Depending on the type of devices and applications used, twenty or more devices may be considered high density."

Information Technology must continue to deploy the newest releases of Wi-Fi standards like 802.11ax (Wi-Fi 6) to keep up with changes in the fast-paced world of wireless networking in order to provide higher data throughput speeds by improving transmission efficiency in high density environments like residence halls and classrooms.[8] The ever-increasing number and diversity of wireless devices on the network compete with each other for bandwidth. To make matters worse, more and more IoT devices are joining our wireless network every day. IoT devices transmit smaller packets, congesting and slowing down the network and affecting the student and faculty experience. For example, the University is using more latency-sensitive applications such as voice and video in the classroom and for collaboration which can be impacted by network performance. Information Technology will need to continue to research and deploy the newest Wi-Fi standards to provide the best user experience. For instance, Wi-Fi 6 wireless access points were deployed with the construction of the Aspen Apartments.

2016 goal update: The 2016 goal was expanded to include wireless coverage for BYOD devices used by students and faculty, and with this update, the goal has been updated to include Internet of Things (IoT) trends.

Goal 4C: Adopt technology solutions where mobility is the ultimate benchmark for the completeness of the solution.

Alignment: Institutional Goal 1, (O1D)

Status: Ongoing

Accomplishments:

Almost every traditional-aged college student (ages 18-29) across the nation owns a smartphone,[9] making it a necessity to provide mobile-friendly technology solutions. For this reason, and the fact that every software vendor has a heightened awareness of providing applications that can be easily accessed from a smartphone or tablet, ensuring mobility considerations are addressed with each project by default. Solutions that fail to meet mobility requirements are quickly removed from consideration, if there are any to begin with.

CMU Mobile has been available since 2015. Many of the software solutions purchased or subscribed to by the University have vendor support apps on the Apple App Store or the Google Play Store. However, the University appreciates that in most cases mobile responsive web applications are the desired support option for vendors. Therefore, CMU's mobile first strategy for adopting online applications and services considers both native apps and responsive-designed applications as equally important and dependent on the type of service provided.

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[8] Hewlett Packard Enterprise Development LP. *What is 802.11AX (Wi-Fi 6)? And why you need it.* Aruba 2018.
[9] Pew Research Center. Mobile Fact Sheet. June 12, 2019. 99% of U.S. adults ages18-29 own a smartphone.

Native Mobile Apps are device-specific and sometimes not supported by older devices, but can be important for process-specific workflows. For example, Panopto' s native app for uploading videos from your smartphone or tablet to their video content management system is very useful. The second approach taken by many vendors is responsive web design. Many of our current software vendors are taking this approach to be device agnostic as content adjusts to fit the screen of any device running a web browser, including older devices. Mobile-responsive designed applications typically provide all features, and menus collapse to now familiar navigation icons on smaller screens. CMU's current ePortfolio product, Digication, is an example of a vendor embracing mobile-responsive web design.

Goal 4D: Explore the use of tablets as a viable desktop replacement for employees where mobility is critical to the success of their position.

Alignment: Institutional Goal 1, (O1D)

Status: Ongoing

Accomplishments:

The first iPads and Microsoft Surfaces hit the market 10 and 8 years ago respectively. Since that time, faculty and staff alike have integrated these convenient devices into their work and classroom settings. These early tablets that met most personal needs had shortcomings for the business, and nearly doubled the cost of computing for each user that requested a tablet in addition to their office computer. In addition to increasing department budgets to purchase tablets and peripherals, iPads with purchased apps and hybridized tablets on the market were still not capable of running most academic software. In 2016, as hybrid tablets became more powerful, the University started watching the market to determine if standard desktops or laptops could be replaced with the tablet computer that would meet both office and mobility requirements within the current technology funding.

This past year, the pandemic brought forward new requests for tablets and mobile computing. Several departments requested tablets for use in the classroom to support hybridized courses or to improve their computer situations at home. Information Technology researched the cost of laptops for faculty and students and found a cost-effective 2-in-1 tablet computer capable of replacing the desktop and provide the mobility and features faculty were looking for in a tablet style device.

This past summer, a cost analysis was performed on changing to a laptop university for full-time faculty. The hardware to provide all full-time faculty (322) a workstation computer setup was reviewed. Hardware specified includes a 2-n-1 tablet computer with docking station and full-size keyboard, mouse and monitor. The proposed solution would deliver faculty mobility along with standard sized peripherals for office time. The total unit cost for the above described workstation

computer setup is $1,400. This is a net unit increase of $500 over the standard all-in-one desktop computer currently purchased at roughly $900.

The overall cost to change to a faculty laptop program was calculated at $450,800. The change would increase the annual cost of the PC Replacement Plan by $26,833 per year before applying any savings by eliminating the need for a secondary mobile computing device. Information Technology is currently reviewing the prospect of a faculty laptop program with academic programs through the Academic Technology Advisory Council. Other considerations still under review are if equipment life cycles would need to be shortened, how non-standard computers would fit into the program, and if hours would increase to support the program.

Goal 4E: Increase the availability and performance of computer applications and systems.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

With enterprise solutions predominantly cloud based, the availability of services is often dependent on the performance of the vendor. Software as a service (SaaS) solutions are often managed contractually through Service Level Agreements. However, CMU has responsibilities to ensure these applications and services are available by implementing reliable networks with failover capabilities when feasible. Over the past four years, the University has taken several steps to ensure that the availability of cloud-based services is not impacted by network outages or internet service interruptions.

In late 2016, CMU added a secondary internet service provider (ISP) to improve network uptime and network fault tolerance in the event of a provider outage. In order to allow for automatic failover between two internet providers, Border Gateway Protocol (BGP) routing was deployed. BGP routes internet traffic through two separate ISPs and announces the University's IP address ranges to both providers. When one internet path feeding the local area network is interrupted, the client traffic assigned to that internet circuit is automatically re-routed to the second. Load balancing client traffic between the two providers is still more of a manual process and will need to be refined moving forward as bandwidth capacity is added with the secondary provider.

Redundant firewalls and wireless controllers have also been purchased since the last update to the *Technology Master Plan*, as well as an upgrade performed to the core network switch. Additional line cards were installed with the last core switch upgrade to provide some redundancy. Further, to meet performance requirements

and support higher data throughput speeds of two ISPs, a pair of redundant internet routers were installed. Over the next couple of years, the University is looking to upgrade its core switch to add redundancy in the data center and to the network edge by adding redundant building network links.

For those software applications required to be installed locally in the data center, Information Technology continues to leverage server virtualization technology to increase the availability of applications and services as the University works toward 24/7 uptime of computer systems. Server virtualization provides functionality such as live migration of running services between hosts, with no user interruption, to eliminate application downtime for planned server maintenance. The technology also automatically restarts virtual machines within minutes on a redundant host in the event of a hardware or operating system failure.

To further improve system uptimes, CMU constructed a new secondary server room as its alternate site with the Health Sciences Center project in 2017 to help diversify virtual server hosts. The new secondary server room provides the necessary protection from large campus disaster by further separating redundant server and storage systems from the primary data center. The secondary server room layout was configured to house all necessary network and server equipment for a redundant site with backup cooling and electrical systems. This location is also the entry point for the University's secondary ISP.

Initiative 5: Efficiently manage university resources.

Goal 5A: Increase faculty involvement in campus technology decisions.

Alignment: Institutional Goal 1, (O1D)

Status: Ongoing

Accomplishments:

The University established the Academic Technology Advisory Council (ATAC) in 2009 to increase faculty involvement in technology decisions. ATAC is comprised of representatives from each academic department, Distance Education, Library, and Information Technology. The Council has been involved in technology decisions ranging from the development of a digital high-definition classroom standard to ways to improve faculty communication of classroom and lab issues with support staff.

Some of the technology topics discussed over the past four years include: as web conferencing platforms and use best practices for instruction, accessibility requirements for online materials and support requirements for e-textbooks, training for plagiarism platforms, collaborative workspaces and moving faculty

email to O365, multifactor authentication, adopting a university-wide online survey tool, lockdown browsers and online proctoring platforms, and research networks.

As campus wide software renewals come due, ATAC has revisited the effectiveness of the tools and if a change needs to be made. A few of the larger software solutions discuss since the last *Technology Master Plan* update include Panopto lecture capture and video content management solution, Adobe Creative Cloud subscription and student licenses, and, at present, Digication ePortfolios.

Goal 5B: Develop a process to prioritize technology projects to best meet the institution's strategic initiatives with available campus resources.

Alignment: Institutional Goal 3, (O3C-S2)

Status: Ongoing

Accomplishments:

Working collaboratively with Purchasing, Information Technology as developed a systematic approach to receiving projects into the project queue. Determining a projects priority is more than a first in /first out approach. The priority given to a project depends on staff skill requirements and their availability, if the project is funded or still waiting budget approval, if it's required due to security or regulatory requirements, or even if it is tied to capital construction project. Small tasks are requested and tracked in the helpdesk ticketing system. New project requests are identified and discussed through the University's budget process. Major projects with funding approval start in Purchasing with either a bid process or Request for Proposal solicitation and continue through the contracting phase which includes a technical review. Internal projects not requiring funding and that do not start with the budget approval process or purchasing requirements are directed to the IT Project Scoping Document.

The IT Project Scoping Document was developed in 2016 to assist in the process of proactively gathering information that is vital to the planning and execution of a newly submitted project. Before the IT Project Scoping Document was developed, the collection of important project details was missed. Examples include compliance with mandated regulations, contractual and licensing concerns, hardware and software requirements, and data confidentiality. The information gathered is used to help prioritize and align resources to the project request as well as develop a timeline for project completion. In addition, Information Technology uses the information to work with Purchasing to complete an appropriate risk assessment to proactively protect the University.

Goal 5C: Expand technology sustainability planning inventories and practices.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

The Technology Sustainability Plan[10] is an integral part of budgeting for technology purchases as well as an effective tool for managing hardware replacements. It provides replacement schedules for computers, servers and storage systems, network equipment, instructional technology, communication systems, and disaster recovery systems. The goal of the Technology Sustainability Plan is to keep the institution moving forward by advancing technology, not just replacing old equipment. This results in the University not replacing hardware and obsolete systems, but rather investing in new technologies to best support the University's mission.

The Technology Sustainability Plan is centrally-funded and managed through the Information Technology Department. Funding for core system purchases is annualized, with a portion of noncapital equipment (e.g., computers, projectors) replaced each year. Funds have increased incrementally as capital building or technology projects are finished and equipment is added to equipment inventories. In FY21, the Technology Sustainability Plan is funded at $1.6 million, up from $1.3 million in FY16, allowing the University to maintain the level of technology currently available to students and faculty across all Colorado Mesa University campuses.

A comprehensive review of the Technology Sustainability Plan was completed in March 2018. The process began by re-evaluating the replacement strategies and equipment lifecycles for each of the funding categories: Servers and Data Storage; Disaster Recovery Equipment; Network Switches; Wireless Local Area Network (LAN); Wide Area Network; Instructional Technology/Classroom Audiovisual (AV); Distance Learning Equipment; PC Replacement; Network Printers; and Converged Technology/PBX Replacement. At the time of the review, the following eight technology projects were underway or recently completed and identified as having a significant impact on Technology Sustainability Plan funding:

1. Upgrade to the virtual server environment and migration of services to cloud-based services with current projects such as Banner XE and OneCard VIP;
2. Replacement of the Storage Area Network and consolidation of network storage as the University's data storage has more than quadrupled over the past four years;

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[10] CMU has developed a comprehensive Technology Sustainability Plan that includes a collection of procedures and equipment inventories used to budget for, analyze, coordinate, and report equipment replacement initiatives.

3. Replacement of tape backup system with a disk-to-disk-to-disk solution and remote site storage for improved disaster recovery planning.
4. Upgrade to the core network switch to provide 10 Gb network connectivity in the datacenter;
5. Planning for unified communications and an IP-based telephone system converged on the local area network to replace the Private Branch Exchange (PBX) telephone system;
6. Migration to Aruba/HP Networking wireless infrastructure for improved performance and cost benefits;
7. Abandonment of video conferencing as distance learning modality with online courses becoming predominant; and
8. Upgrade of classroom AV systems for entire academic buildings on an ongoing basis as originally installed with capital construction projects.

The 2018 review found the majority of the equipment categories to be fully funded with the exception of Servers and Data Storage and Instructional Technology/ Classroom AV which were not fully funded. However, overfunding in Disaster Recovery Equipment and Distance Education Equipment (by elimination of video conference systems) helped offset the replacement funds for servers and classroom AV, respectively. In addition, it was determined that a few of the equipment lifecycles could be extended without negatively impacting system uptime, for example, the lifecycle for servers was extended to five years.

Information Technology more recently completed a review of the PC Replacement, Network Switches, and Instructional Technology /Classroom AV equipment inventories, costs and life cycles based on current technologies. As of fall 2020, there are a total of 2,970 computers on the PC Replacement Plan, of which 1,627 computers are in labs. An analysis of computer assets and associated unit costs shows funding for this technology category to be effectively funded, and the University is moving to determine the feasibility of funding a Faculty Laptop Program for full-time faculty (See Goal 4D). The Network Switches category is also under review taking into consideration future a fully gigabit edge switches with power over ethernet requirements and expanding the need for higher speeds and redundancy between buildings. To help align the current funding with future equipment needs, the University is exploring increasing the network switch replacement cycle from 5 to 7 years. Last, Information Technology has finalized a review of the 231 technology-enhanced classrooms on the replacement inventory. Taking into consideration the most recent integrated video switchers, digital signal processors, control processors, and wireless presentation from the manufacture and developing a strategy to replace the entire classroom AV system on an 8-year cycle, the University has been able to work through the replacement funding shortfall identified in the 2018 review.

Goal 5D: Recruit and retain well-qualified IT staff.

Alignment: Institutional Goal 1, (O1C, O1E)

Status: Ongoing

Accomplishments:

The University's technology resources are centrally managed and supported by the Information Technology (IT) department. The centralized management of IT systems and services is in part why the University continues to maintain a low IT operating budget, roughly 4.5% of Educational & General and Auxiliary funding. Over the past four years, the IT department has only added one (1) FTE in the Telecommunications and Instructional Technology unit, however, the IT department was only fully staffed for the first time in many years at the start of the 2019 academic year. The only organizational change since the last *Technology Master Plan* update is the Vice President for Information Technology now reports directly to the President and is a member of the executive team.

The need to add a second an AV Technician/Crestron Programmer in Telecommunications and Instructional Technology was threefold: 1) keep up with the increased workload to support and maintain the increasing number of technology-enhanced classrooms; 2) provide position redundancy /cross training for classroom Crestron control systems and specialized AV equipment that classroom functionality depends on, and 3) support classroom AV upgrades as part of the Technology Sustainability Plan. When funding for the position was approved in FY17, the number of technology-enhanced classrooms supported was 207. At the current number of classrooms, 231, Instructional Technology staff have to replace equipment and upgrade system code in roughly 29 classrooms per year to keep pace with the established 8-year classroom AV refresh cycle.

The Information Technology department has been very stable and continues to build on a very talented core of individuals. The one work unit in the department that has had any significant turnover has been Computer Support Services. Computer Support Services staff and the students employed in this area are part of an effective cross training and professional development program. It engages staff and students alike on current technologies and support procedures. Staff are required to take part in a self-training program and certification process for HP and Apple hardware as well as CompTIA A+ Certification training to improve morale and individual skill sets with scheduled release times during office hours for studying. Students have a similar structured student-training program, leading to certification as a 'student technician'. Computer Support staff developed a comprehensive training program and internal skills certification process that helps students develop professionally and build confidence in performing their assigned duties.

Cross training is emphasized and practiced across the Information Technology staff. For example, members of the Computing and Network Systems unit continually cross train with at least one other member of the team in order to

improve working knowledge of systems to ensure support can be provided when a professional staff member is out of the office or otherwise unavailable. Similar cross training practices are instituted for Banner Systems, telecommunications and Instructional technology and Computer Support Services. Further, position responsibilities include engaging in cross training activities within the department and are part of the evaluation process.

Last, Information Technology began augmenting the Information Systems team with Ellucian's Application Managed Services (AMS) in 2016. This change predominantly came about with the retirement of the institution's Oracle Database Administrator.   Four years later, the AMS team has been instrumental in performing numerous system upgrades of Customer Relationship Management (CRM) applications Recruit and Advise as well as the extensive process of upgrading Banner 8 to Banner 9 Administrative and Self-service applications. CMU is now able to upgrade to new releases and patches of Banner within weeks of release assuring that the University is running on the latest versions of software.

Goal 5E: Enhance IT Help Desk support services.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

Information Technology staff members are continually enhancing helpdesk services to support the University's mission and ensure users are getting the most out of their technology experience. The Help Desk supports the mission through installing software, deploying computers, integrating learning equipment and systems, and assisting users with connectivity related issues. Since 2016, the number of service requests have increased by 21% overall which is not surprising with the number of software applications and computers supported increasing by 41% and 15%, respectively over the same time period. Wireless clients on the network have also increased. In fall 2020, there were more than 20,000 wireless devices registered on the CMU WiFi network. More than 130 service request categories are tracked each year. A few notable support categories are addressed below to provide context to the overall approach to assisting users on the growing number of applications and devices available.

To help support users, the Information Technology Help Desk has made significant resource investments in developing help documents and support platforms. End user documentation is continually updated with Information Technology undertaking at least two major reviews of its website and the organization of its contents over the last few years to help users find relevant self-help documents based on their role of student, faculty, staff or visitor. In addition to the traditional contact channels—Web Help Desk (ticketing system), email and

telephone—the Help Desk has focused on adding new ways for users to connect with staff in real-time with instant messaging, web chat, and remote-control software. Other tools used by the Help Desk staff include an in-house developed portal support portal that aggregates support utility programs and reference information for helpdesk technicians and an in-house developed, mobile-responsive application CMU Classroom Computer Lab Software Lookup Tool to make it easy for students and faculty to search for what desktop software and version is deployed to a classroom or lab, dramatically reducing the number of discovery requests.

To combat the support needs of an ever-increasing number of wireless clients on campus, support staff have taken a combined training and technology approach. First, to assists students that have only been introduced to home networks until now, staff delivers instruction on key help topics, including the University's wireless network, through Freshman Year Initiative classes. Although this does not replace working with students on a one-on-one basis at the helpdesk counter or by telephone, it offers a small group support session to help students get familiar with connecting wireless devices during their first week on campus. Second, improvements over the years to "Get Connected" help documents have made inroads to curtailing the number of connection related tickets over the years. These Get Connected documents, fashioned after commonly known quick start guides, are easy to follow and more visible to users when they need them most, online through on their smartphone and a paper copy on their desk in their residence hall room. Last, an important technology investment has been made to device onboarding with Aruba ClearPass. The ClearPass solution makes it easier for students and employees to registering their personal devices and connect consumer-grade wireless clients like voice assistants, media streaming devices, and wireless printers to the University's enterprise network.

Another key area of support has been with the learning management system, D2L. The Information Technology Help Desk has collaborated with the Distance Education Instructional Designers to build documentation without duplication of efforts, and has provided Instructional Designers with accounts on the Web Help Desk ticketing system. Using the ticketing system in this manner, Help Desk staff can escalate D2L related tickets directly to the Instructional Designers giving the end user faster resolution to D2L issues. This collaboration has also improved the D2L skill set among Help Desk staff, which also promotes faster support responses.

Moving forward, the use of AI/machine learning is being researched and implemented across campus. Computer Support Services is investigating the use of an AI chatbot to provide a more responsive self-service help tool that will deliver accurate self-help documents and answers. The end goal is to enable the user to find the correct answer on their own, eliminating the need for a service ticket. Combined with the aforementioned help tools, users will experience a multi-tiered approach to support, beginning with the AI providing the most correct answers to

their question or issues, moving on to web chat or instant messaging, then Web Help Desk (service ticket), and finally a direct conversation with Help Desk staff.

Goal 5F: Leverage cloud-based software and services where practical, economical, and provides appropriate levels of information security.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

The University defines an enterprise application as software that is interdepartmental, large in scale, or critical to the University's operation, or of a smaller scale but tied to the Enterprise Resource Planning system. Examples of enterprise software include large applications such as the student information system, online payment system and learning management system, and smaller business applications like room scheduling, student conduct and housing management software. Information Technology currently supports 79 enterprise applications. Not including infrastructure management software (e.g. wireless management software) utilized by Information Technology and Facilities Services, 59% of the enterprise applications used today for daily activities are cloud-based or delivered as Software as a Service (SaaS). The use of SaaS applications has become prevalent in our daily lives, and the percentage cloud-based software used by the University is expected to continue to increase.

Commonplace today is the move of business email and communications and file storage to the cloud. In 2019, CMU was no different, when it completed the migration of faculty and staff email accounts to Microsoft's Office 365 cloud offering to reduce operating costs. Operating cost savings range from eliminating system administrative time to preform server upgrades and system backups to reducing file and backup storage and licensing costs, and eliminating the cost of email spam filtering services. The Office 365 solution maintains necessary management tools and security controls to properly administer employee accounts as well as provides mobile apps and up-to-date features.

Over time, CMU has developed a comfort level with moving larger enterprise applications like the ERP and the student information system to the cloud. As the University looks to modernize its ERP systems it will evaluate cloud hosted environments like Amazon Web Services or other solution provider recommendations for major financial and student information systems.

Initiative 6: Advance campus technology in support of institutional initiatives and campus expansion projects.

Goal 6A: Continuously enhance instructional technology standards to provide innovative teaching and learning environments.

Alignment: Institutional Goal 1, (O1D)

Status: Ongoing

Accomplishments:

The University continues to invest in classrooms, labs and instructional technology in support of its core mission. The number of technology-enhanced classrooms with integrated systems has increased to 231 from 207 in 2016. Most notable, ten classrooms were constructed with the new Health Science Center in 2017, and sixteen engineering classrooms were added with Confluence Hall in 2018. These classrooms have standard high definition digital switching, laser projectors, and widescreen projection screens with a standard set of input/source equipment including wireless presentation equipment. Further, as part of the technology sustainability planning, classrooms continue to be upgraded to the latest standard. Since the last *Technology Master Plan*, 120 classrooms were upgraded, included all the classrooms on the Montrose Campus.

In addition to traditional classroom spaces, technology advancements continue to be an integral part of making the best learning environments, with experiential learning opportunities, available to students and faculty. A couple of example projects performed over the last four years demonstrate this commitment to innovative learning environments. First, CMU opened its new Health Sciences Center fall 2017 that provides students a new state-of-the-art facility including a radiology lab and nursing simulation labs with a medical simulation capture solution integrated with Laerdal medical manikins. This project required significant computer support services time for implementing electronic medical record training systems. Second, in 2018, the University opened its new Cybersecurity Center designed to provide students a safe environment to gain valuable experience in this field. The space designed in coordination with the Maverick Innovation Center, includes a server room with isolated cabled and wireless local area networks and lab space. Considerable effort went towards the coordination of servers and network equipment, including firewalls, computers, and internet connectivity for the Cybersecurity Center. Other learning spaces resourced over the last couple of years include, but are not limited to, the new Lineworker facility that opened in 2019 and Maverick Hotel that opened in 2020.

Classroom equipment and capabilities are constantly reviewed. To assist instructors required to wear face coverings when lecturing due to the COVID-19 pandemic, wireless USB microphones were purchased to support lecture capture and provide voice amplification in classrooms. Two hundred thirty-seven smart classrooms were retrofitted over the summer of 2020 to support the USB microphones. Instructors opting to use the wireless microphone were given their

own wireless headset or hand-held microphone and base unit to limit equipment sharing.

Goal 6B: Evaluate unified communication and call center solutions.

Alignment: Institutional Goal 3, (O3C)

Status: In-progress

Accomplishments:

Since the 2016 Technology Master Plan was developed, Information Technology has undergone an extensive discovery process of unified communications[11] and call center solutions. In 2016, Information Technology worked on the evaluation of Microsoft Lync as a possible voice-over-Internet Protocol (VoIP) telephone solution to replace the University's 20 plus year-old Private Branch Exchange (PBX). As the Microsoft's solution evolved over the past four years from Lync to Skype for Business and now Teams, Information Technology has been analyzing Microsoft's collaborative workspace and unified communications product, Teams, as a possible solution due to its growing capabilities and the potential cost savings to the institution.

The unified communications and call center discovery process has been delayed several times due to higher visibility projects competing for staff time. The project was given a higher priority when the University's PBX maintenance vendor announced the end of support for the voicemail system 2019, and subsequently again when remote work became a requirement during the COVID-19 pandemic in 2020. However, the delay of the project may ultimately save the institution millions of dollars as at least two generations of VoIP systems were skipped and the University started investigating the Unified Communications as a Service (UCaaS) solution of Microsoft Teams and the predominate use of softphones.

Information Technology's research in 2019 found the adoption trend for enterprise unified communications to be Unified Communications as a Service (UCaaS) solutions and not on-premise systems. From a budgetary perspective, UCaaS is a shift from a capital technology purchase to an increase in operational expenses. The review of several prominent UCaaS providers found the costs of these subscriptions to range from $160k to $250k per year. The annual cost of competing services influenced the decision over the last couple of years to focus on Microsoft Teams. Further, Microsoft's O365 cloud-based applications for email, instant messaging, and file sharing have been used for several years, and Microsoft Teams has been adopted as the institution's conversational workspace

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[11] Unified Communications is a suite of products to provide business calling features; audio and web conferencing including screen/application sharing; voicemail and unified messaging; presence and instant messaging through a unified interface with business application integration. More recently, unified communication has included conversational workspaces for project collaboration.

for collaboration. However, through the discovery process of unified communications, it was recognized that reliability and telephone call quality have been mainstays of traditional PBX systems for decades, and these telephony characteristics, and not cost alone should drive the decision.

Maintaining reliability and a high quality of service is heavily dependent on network performance. Over the past year, Microsoft Teams voice calling features were trialed to determine if Microsoft Teams would meet the University's telephone requirements. Once successfully deployed, Microsoft Teams, assisted by the widespread use of web conference tools during the pandemic, diminished concerns of call quality and reliability. With few exceptions of offices requiring contact-center-lite system features, Microsoft Teams, with add-on Phone System and Audio Conferencing licensing, was found to be an acceptable and cost effective UCaaS solution for the University. Further, the use of web conferencing platforms during the pandemic have made academic departments more comfortable with the use of softphones, and academic departments have agreed to move with softphones as part of cost saving initiatives developed during the pandemic.

Information Technology is still working through the final details such as network configuration, E911, and public switched telephone network connection options and pricing for local and long distance calling. The current Teams configuration is utilizing Microsoft's direct routing and a Session Border Controller connected to existing telephone trunks to the central telephone office. Information Technology plans to review UCaaS calling plans or transition to Session Initiated Protocol trunking in a second phase of the UCaaS project. Moreover, Information Technology is still researching solutions to provide call center functionality for Admissions and IRIS (Integrated Resources for Information and Solutions).

By deploying Microsoft Teams with voice calling with softphones as a complete unified communications solution, the University gains several feature benefits while reducing capital expenditures and lowering operational costs. Teams voice calling benefits include unified messaging for voice and email along with voice message transcription, mobility options to support remote work requirements, improved direct search and dialing options, and easy launch of individual, team and department calls from a chat, calendar event, or contact. The upfront cost savings to the University is significant. Information Technology has identified an estimated initial savings of $173k[12] by using softphones and not purchasing desktop telephones. Additional savings may also be realized by reducing power over ethernet network switch ports that would be required for VoIP desktop telephones.

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[12] Information Technology has identified an initial savings of $173k by not purchasing desktop telephones and promoting the use of softphones which also reduces the annual technology sustainability costs by an estimated $30k. The ongoing Teams licensing costs are far less than other UCaaS services priced. It is estimated that the university will save over $100k per year in cloud service charges.

Goal 6C: Develop an Information Technology standards guide to improve communication with architects and design teams.

Alignment: Institutional Goal 3, (O3C)

Status: Ongoing

Accomplishments:

The University continues to work on technology standards in support of capital construction projects and classrooms upgrades. A structured cabling system specification has been in place for more than a decade. A list of connection types and cable quantities is provided with the structured cabling specifications to design teams at the onset of capital projects. In addition, well-defined outdoor communication vault and pathway requirements have been established. Audiovisual standards have proven to be more difficult to fully define due to how quickly technology changes. Although classroom input device standards have been established with the Academic Technology Advisory Council, a full design specification must be reviewed with each project in collaboration with the space user and design teams considering department and or program requirements.

As time permits, an IT standards and pre-construction planning guide will be developed for design areas where practical. The proposed guide would consist of telecommunications and audiovisual standards for capital project design teams who are involved in telecommunications infrastructure and classroom/meeting room projects for the University.