



2024 Technology Master Plan
March 29, 2024

Colorado Mesa University
Grand Junction, Colorado

Executive Summary

Approved in 2023, Colorado Mesa University's *Forming the Future* Strategic Plan is built on five pillars:

- Educational Programs—Provide innovative, flexible educational programs that meet the needs of western Colorado and beyond.
- Cultivating Collaboration and Innovation—Lead the community and region in activity that is economically, intellectually, and culturally transformative.
- Promoting and Enhancing the Value of Higher Education—Build and share a transformative higher education experience.
- Recruit and Retain Employees for a Human Scale University—Commit to a work culture where each employee is seen, valued and respected.
- Student Sense of Belonging—Build a culture that bonds students and alumni to CMU.

The Strategic Plan's pillars and accompanying objectives serve as the basis for CMU's subsequent planning efforts that include the institution's current technology planning, the focus of this document.

Along with the Strategic Plan, broader technology trends are a second, important consideration of IT's planning efforts and influence the University's investments in technology. Four trends are relevant to the current planning effort, two of which are a continuation from the 2020 *Technology Master Plan* and two that are new to the 2024 plan. The first, Digital Transformation, remains relevant to the 2024 master plan initiatives as it is still at the forefront of modernizing higher education systems and the user experience. Similarly, Immersive Learning Environments, such as virtual reality, also continue in importance as they expand opportunities for unique, repeatable learning experiences in higher education.

Now in 2024, IT staff members have identified two additional trending technologies to its planning framework: Artificial Intelligence (AI) and Data Fabric. AI took the world's center stage in 2023 as OpenAI released ChatGPT, accelerating the conversation around all branches of AI, its possibilities, and its challenges to higher education. Meanwhile, the concept of a data fabric is an emerging management and integration strategy to improve how institutions:

- build flexibility into their enterprise systems;
- deploy better data orchestration processes that integrate data from multiple sources, making them more useful to users; and
- develop better data governance for overseeing and monitoring the access, integrity, and security of data.

Yet a third element that is part of the 2024 *Technology Master Plan*¹ is the mission, staffing, and funding of the University's Division of Information Technology. Investments in technology resources must be purposeful, support strategic initiatives, and deliver on business outcomes. The IT Division is committed to being responsible

¹ Unless otherwise referenced, the *Technology Master Plan* or *Master Plan* refers to the 2024 version.

stewards of taxpayer dollars by reducing the risk of financial loss, optimizing operational processes, and measuring institutional performance. Further, for CMU to be competitive in the recruitment and retention of students, faculty and staff, available technologies are an integral part of a quality experience.

A dedicated professional IT staff works to achieve the Division's goals and initiatives in alignment with the University's Strategic Plan through its various responsibilities. These include deploying and maintaining technology across all campuses, securing its systems and data, supporting innovative teaching and learning environments, and providing access to electronic information to assist a diverse community of students, faculty, and staff members.

Taken collectively, the *Forming the Future* pillars and strategic objectives, technology trends, and institutional resources have shaped the Information Technology Division work in identifying five major initiatives that will guide its investments over the next four years:

Initiative 1: Advance the University's information security program and IT governance structures to manage regulatory compliance and cybersecurity risk.

Initiative 2: Advance learning environments and the student experience in support of the 21st century teacher/learner.

Initiative 3: Through a cloud-smart approach, replace legacy applications to modernize the University's operations for continuous delivery of new business capabilities and innovation.

Initiative 4: Develop a modern data management and analytics strategy to enable better use of the University's data assets for enhanced decision making across administrative and educational functions.

Initiative 5: Modernize how Information Technology creates and delivers services to its customers and provides business value to the University.

The *2024 Technology Master Plan* offers goals and a detailed description for each of the IT initiatives in addition to summary tables that directly link them to *Forming the Future* objectives. What is increasingly obvious is that the ever-expanding availability of and demand for emerging technologies are continuing to push higher education institutions, like other business enterprises, into changing how an organization's work is getting done.

In addition to the above, four informational items are attached as appendices. A brief overview of CMU is found in Appendix A. Appendix B documents the institution's history of technology planning since it began in 1999. Appendix C provides the 2020 institutional strategic planning goals referenced in Appendix D which summarizes IT's past accomplishments towards the 2020 IT Initiatives, thereby providing insights into more recent technology decisions and funding sources.

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I. Introduction

The primary purpose of the Colorado Mesa University *2024 Technology Master Plan* is to identify technology initiatives that are aligned with the University's initiatives and objectives articulated in the *Forming the Future* Strategic Plan. Staff members from the Division of Information Technology (IT) revise the Master Plan every four years as a follow up to updates of the institution's Strategic Plan.

To put the current initiatives in context, the current *Master Plan* lists the pillars and objectives from *Forming the Future* in Section II. Section III is a description of four trends that give critical guidance for planning the future of technology at CMU: digital transformation, immersive learning environments, artificial intelligence, and data fabric. These innovations, along with other current and emerging technologies, are continuing to reshape how the institution meets its business needs and the needs of its users. Finally, additional context for the plan comes from the Division's mission, staffing, and funding in Section IV, and past accomplishments to provide insights into more recent technology decisions and funding sources in appendices.

Five initiatives reflect IT priorities and form the core of the *Technology Master Plan*. In short, they are:

- manage regulatory compliance and cybersecurity risk through advancements in IT's security program and governance structures;
- enhance the student experience by supporting effective teaching and learning environments;
- modernize University delivery of business capabilities by replacing legacy applications;
- make better use of the CMU's data assets for enhanced decision making across administrative and educational functions; and
- modernize how Information Technology creates and delivers services to its customers.

The Division's initiatives are more fully described in Section V and document how they are aligned with *Forming the Future* strategic objectives. It should be noted, however, that for successful completion of technology initiatives, interdepartmental cooperation with IT is needed in order to meet the demands of an advancing university.

II. 2023 Institutional Strategic Plan's Pillar and Objectives

The 2023-2027 *Forming the Future* Strategic Plan was approved by the Colorado Mesa University Board of Trustees on May 19, 2023. The plan is built on the following five pillars and their supporting objectives:

Educational Programs Pillar: Educational Programs—Provide innovative, flexible educational programs that meet the needs of western Colorado and beyond.

Objectives:

- [1] Develop exceptional programs, aligned with our mission, that empower CMU graduates and regional employers to thrive in a global society.
- [2] Support program revision, collaboration, and revitalization, maximizing existing resources and faculty areas of expertise, to meet student and market needs.
- [3] Leverage advances in technology and digital learning to implement high-quality and engaging educational experiences.
- [4] Make experiential learning opportunities — and other high-impact practices that draw on the resources of our community and region — a defining feature of a CMU education.
- [5] Prioritize excellence in teaching, learning, course delivery, curriculum design, and program development.

Collaboration and Innovation Pillar: Cultivating Collaboration and Innovation—Lead the community and region in activity that is economically, intellectually, and culturally transformative.

- [1] Encourage, identify, and support ideas to accelerate the research, innovation, and entrepreneurial ecosystem of CMU and western Colorado.
- [2] Engage all stakeholders in robust programming and meaningful partnerships that create value for the region.
- [3] Develop an environment of lifelong learning by emphasizing education and professional development for alumni, students, faculty, staff, and community.
- [4] Pursue opportunities to grow the capabilities of CMU at all its campuses through collaborations with donors, businesses, organizations, and other institutions of higher education with shared values.

Value of Higher Education Pillar: Promoting and Enhancing the Value of Higher Education—Build and share a transformative higher education experience.

- [1] Invest in creating a transformative experience for each student.
- [2] Inspire a positive narrative about higher education and the unique student experience at CMU.
- [3] Promote a range of career opportunities that require varying levels of college education.
- [4] Deliver a quality, affordable education with lifetime professional and personal returns.

Employees Pillar: Recruit and Retain Employees for a Human Scale University—Commit to a work culture where each employee is seen, valued and respected.

- [1] Create a culture that embraces standards for CMU employee excellence and celebrates efforts to meet them.
- [2] Value employees through clear and equitable compensation strategies.
- [3] Foster mutually respectful and collaborative decision-making processes that value the unique roles and expertise of our faculty (i.e., via shared governance) and staff.
- [4] Support employee well-being.

Belonging Pillar: Student Sense of Belonging—Build a culture that bonds students and alumni to CMU.

- [1] Encourage a welcoming, supportive, and mutually respectful relationship between faculty/staff and students.
- [2] Strengthen clear, transparent, and frequent communication to students about available services, activities, and resources.
- [3] Honor our students' individual academic, cultural, generational, and geographic experiences while also providing impetus for them to build relationships with multiple groups, both on- and off-campus.
- [4] Design visible and virtual spaces that foster connections among students, faculty, and staff.
- [5] Create an environment that supports and guides success, starting from the day students choose to be a Maverick and extending through their status as alumni.

III. Technology Trends

An important component of technology planning is identifying trends that will influence the University's investments as IT initiatives are prioritized and implemented. Two trends included in the *2020 Technology Master Plan* – Digital Transformation and Immersive Learning Environments – are still relevant to the 2024 plan, while two others – Artificial Intelligence and Data Fabric – have emerged more recently for inclusion here.

Digital Transformation

Over the past several years, the University has implemented numerous applications to improve the student experience and gain administrative efficiencies in order to keep pace with student expectations and employee demands for consumer-like solutions that are accessible anywhere at any time. Recent examples where the University has made significant investments have involved:

- revitalizing MAVzone,
- advancing CRM technologies for recruitment and student success,
- deploying applicant tracking software for employee recruitment, and
- implementing e-forms and workflows.

A complete digital transformation, however, goes beyond eliminating paper forms and streamlining business processes. It is not one technology project or process-improvement initiative. Rather, it is a comprehensive, philosophical change that focuses on the end user and adopts models for conducting business differently, such that it changes the customers' perceptions of the institution.^{2,3} At its core, then, digital transformation creates seamless student experiences⁴ – both academic and administrative – regardless of whether the services are delivered online or in person, support is available by machine or staff, or the learning environment is offered virtual or traditional.

Technologies that enable digital transformation include, but are not limited to, mobile, cloud, the Internet of Things (IoT), predictive analytics, and artificial intelligence. The following are current projects that illustrate how CMU is transforming its digital presence:

- Modernizing the Enterprise Resource Planning (ERP) solution. This project includes an enhanced user experience, cloud computing, and a well-defined data integration strategy. A more composable approach to ERP systems and enterprise applications will enable the University to adapt quicker to customer needs.
- Augmenting service operations to provide seamless, personalized support in person and online. Enhanced self-service options (through intelligent agents and

² D. Christopher Brooks and Mark McCormack. *Driving Digital Transformation in Higher Education*. ECAR research report. Louisville, CO: ECAR, June 2020.

³ Malcolm Brown, Betsy Reinitz and Karen Wetzell, "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."

⁴ 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."

conversational language technologies) and mobile apps to assist students and employees complete tasks.

- Automating business processes to improve operational efficiencies, reduce data errors, and improve communication streams. Continual improvement of CRM applications, digitalization of employee onboarding, and development of advanced workflows are representative of these improvements.
- Adopting collaborative workspaces to advance communication practices. 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 greater collaboration and interaction.

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 to the point that, not only are they increasingly comfortable with their use, but often expect these kinds of environments 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.

Artificial Intelligence

The potential of artificial intelligence (AI) has been a buzz for decades, with the idea of AI dating back to the mid-1950s.⁵ However, AI took the world's center stage in 2023 as OpenAI released its natural language processing platform, ChatGPT. Its release has

⁵ Dartmouth <https://home.dartmouth.edu/about/artificial-intelligence-ai-coined-dartmouth>

accelerated the conversation around AI's possibilities and challenges, with the explosion described by some as a "printing press moment."⁶

Generative AI (GenAI) and Adaptive AI are two forms of AI that have a growing presence in higher education. ChatGPT is a conversational form of Generative AI, and as its name indicates, GenAI generates, or creates new content in the form of text, graphics, and code, etc. GenAI has many uses across all industries, using chatbots to improve customer service, create marketing materials, and write code in popular computer programming languages.

While Generative AI has most recently taken the world by storm, Adaptive AI is central to modern technology platforms. Because it is capable of continuous learning or adapting to changing environments, Adaptive AI can be leveraged to learn user preferences and make recommendations to improve customer service chatbots, to analyze student preferences to suggest generative learning activities, and to identify patterns in cyber-attacks leading to recommendations for continually improving security software.

Both forms of AI – Generative and Adaptive – will be central to campus technology discussions now and into the future, illustrated by the following examples of how they will transform campus technology and University business:

- **Analytics.** Data store for analytics (i.e., data warehouse, data lakes) and business intelligence tools leverage AI to dynamically identify and support new uses and analyses. Applying predictive analytics as part of AI-enhanced early warning systems, to students likely to be at-risk of not persisting to graduation, can be identified along with a proactive retention support plan.
- **Adaptive Learning.** AI will be available to personalize a student's learning experience based on past activities and recommend learning content or services that would benefit the student. For example, a student could be presented with a personalized tutoring schedule for a course-specific learning outcome by leveraging AI.
- **Information Security-Threat Intelligence.** Advanced cybersecurity tools leverage AI to analyze the behavior patterns of user accounts in order to identify account compromises or malicious software, as well as act proactively to alert security professionals and protect user accounts.

In short, the applications of AI appear unlimited as it plays a prominent role in newly-released technologies. Moving forward, AI will undoubtedly have a dramatic impact on most technology systems and service discussions.

Data Fabric

In recent years, the University has been confronted with 1) integrating data between its numerous business applications and 2) efficiently maintaining data integrations. Data integrations tend to be fragile and the synchronization of data between applications is a

⁶ Past printing press moments—dramatic change in how we create, share, and consume information—include the invention of the printing press, radio, television, internet, and social media.

constant challenge. The concept of a data fabric is an emerging management and integration strategy that offers at least three significant improvements for institutions. They 1) build flexibility into their enterprise systems; 2) deploy better data orchestration processes that integrate data from multiple sources, making them more useful to users; and 3) develop better data governance for overseeing and monitoring the access, integrity, and security of data.

Gartner, a leading technology consulting firm, defines a data fabric as a concept that serves as an integrated layer, or fabric, of data and connecting processes.⁷ The development of a data fabric will enable better data sharing and manage the flow of data from business applications and other data sources and out to data consumers – applications, processes, and business units – resulting in greater operational efficiency.

According to Gartner, 65% of the cost of implementing either a new Human Resources/Finance/Student Information System or an all-in-one Constituent Relationship Management system is attributable to integrations.⁸ Today, CMU's Information Technology staff members support over 90 enterprise applications, with more than 50 of the applications exchanging data with the University's current thirty-year-old Banner systems for Human Resources, Finance, and Student Information.

The development of a data fabric to include a data hub, integration platforms, and data store for analytics will support the institution's Human Resources and Finance Systems transformation projects. Further, it will reduce the initial and ongoing cost of supporting data integrations between business applications as well as enhance data analytics for use by the institution's decision-makers.

⁷ Gartner Research: What is a Data Fabric Design? April 14, 2021, by Robert Thanaraj, Mark Beyer, and Ehtisham Zaidi

⁸ Hype Cycle for the Future of Enterprise Applications, 2023. Gartner, July 18, 2023, by Patrick Connaughton, Tad Travis, Mark O'Neill, Kevin Matheny, and Stephen Emmott

IV. An Overview of Information Technology at Colorado Mesa University

Information Technology Mission

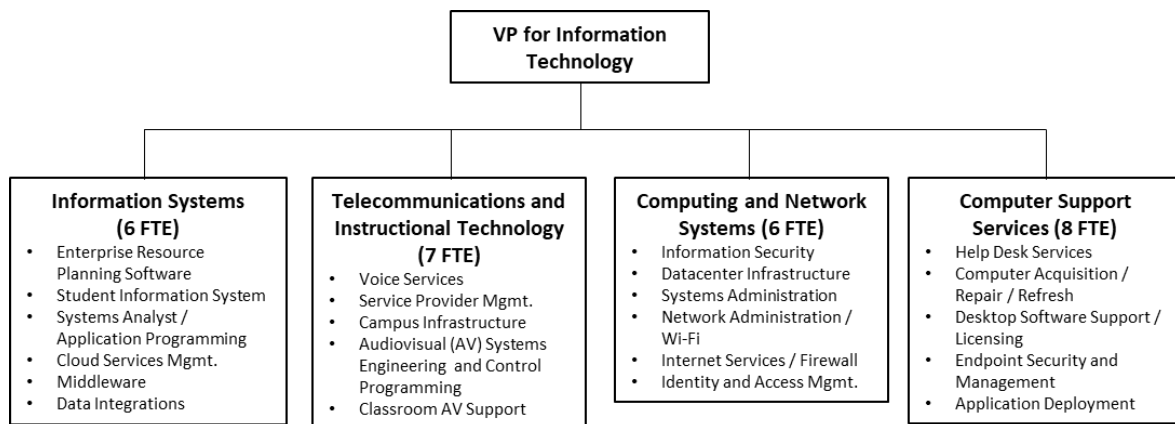
Information Technology serves Colorado Mesa University by strategically deploying technology, enabling the institution to achieve its goals. With a dedicated professional staff, Information Technology provides support for innovative teaching and learning environments, reliable and secure administrative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

Information Technology Organizational Structure

The University's technology resources are centrally-managed and supported by its Information Technology (IT) Division, which is conducive to maintaining lower operating costs, securing information systems, and streamlining project implementations. IT is led by the Vice President for Information Technology and is comprised of twenty-eight (28) full-time equivalent (FTE) staff, allocated across four units, who work closely to meet the goals of the division and University.

The organizational structure of the IT Division and work unit responsibilities are summarized in Figure 1. Core IT systems and networks are supported entirely by staff located on the main campus. Computer support and help desk services are mainly provided from the main campus, except for a technician located at CMU Tech. While the IT Help Desk services are under the direction of the Director of Computer Support Services, Help Desk responsibilities are integrated into the positions of each unit.

Figure 1. Organizational Structure of the CMU Division of Information Technology



Information Technology Funding and CMU Finances

Investments in technology must be purposeful, support strategic initiatives, and deliver on business outcomes. The IT Division is committed to being responsible stewards of taxpayer dollars by reducing the risk of financial loss, optimizing operational processes, and measuring institutional performance.

Information Technology oversees campus-wide technology funds with a few exceptions. IT operational funding is at an all-time high for the institution, although the operating budgets and staffing levels are considered lean by most campus standards as the comparisons from Gartner Research⁹ reflect below. In FY2023-24,

- The IT annual operating budget was \$7.6M or 3.7% of the University total operating budget of \$206M. Included in the Division's operating budget is the equipment refresh that is currently funded at \$1.6M as part of the University's comprehensive Technology Sustainability Plan. According to Gartner, the median IT spend as a percentage of operating expense is 5.7% across all revenue sizes, and 7.4% for institutions under \$250M in revenue.
- IT's 28 FTE is 3.6% of the University's current 787 Total FTE. According to Gartner, the median IT FTE as a percentage of employees is 4.2% across all revenue sizes, and 5.7% for institutions under \$250M.

Keys to maintaining a tight IT operating budget are responsible oversight and monitoring of campus-wide budgets and projects, well-established campus technology standards for most hardware, and rigorous purchasing and contract negotiating processes. In addition, IT staffing levels have been sustainable, in part, due to the adoption of cloud delivered and Software-as-a-Service applications. For example, the University contracts with Ellucian's Cloud Managed Services to provide outsourced Oracle database administration and software support for all licensed Ellucian software including Banner ERP—HR, Finance and Student Information Systems. While the outsourcing is approximately the same as if CMU managed the services in-house, contracting for the services gives CMU greater staffing flexibility to support strategic projects than apply software upgrades and patches.

It is also important to underscore the significant role that information technology plays in making CMU competitive in the recruitment and retention of students, faculty, and staff members. Available technologies are an integral part of a quality educational experience, be it in the classroom or lab or as part of research on a scholarly project. The challenge of competing for students is illustrated by enrollment data from the National Student Clearinghouse Research Center. Nationally, enrollment in two-year and four-year public institutions remain below pre-pandemic levels.¹⁰ With fewer traditional-age college students in the market in 2025 due to a decline in birth rates in 2008, coupled with the ongoing effects of the pandemic,¹¹ universities are competing for a declining number of traditional college-aged students who have high expectations for the technology available at their institution. Thus, IT plays a role in a student's initial and ongoing commitment to CMU, thereby affecting enrollments and ultimately the institution's budget.

⁹ Gartner Research, IT Key Metrics Data 2024: Industry Measures—Education Analysis. December 14, 2022. ID G00801247, Eric Stegman, Jamie Guevara, Shaivya Kaushal, and Aditi Sharma.

¹⁰ National Student Clearinghouse Research Center, Spring 2023 Current Term Enrollment Estimates Report, May 24, 2023.

¹¹ Inside Higher Ed, A Second Demographic Cliff Adds to Urgency for Change. Ray Schroeder, May 18, 2021.

IT also becomes a consideration in attracting potential faculty members. Their over-riding responsibility is to prepare their students to succeed in their future workplace where technological applications are increasingly commonplace. To effectively meet that responsibility, faculty members require IT investments in software, equipment, and online services for use in the classroom and labs. While some on-the-job training might be available, employers expect graduates to come with a fundamental working knowledge of the technology tools used in their field. Additionally, scholarly projects are often reliant on available technology support and can affect a faculty candidate's willingness to accept a position at CMU.

V. Information Technology Initiatives

In its *2024 Technology Master Plan*, CMU's Division of Information Technology has identified five major initiatives that are aligned with the institution's Strategic Plan pillars and objectives. Serving as the organizational structure for prioritizing major projects for the next four years, the initiatives focus on five key areas:

1. Information Security
2. Instructional Technology and Student Engagement
3. Digital Transformation
4. Data Management and Analytics
5. Modernizing the IT Service Portfolio

Below are two examples of how IT initiatives relate to the *Forming the Future* pillars.

- First, as established by the *Forming the Future* pillar for Promoting and Enhancing the Value of Higher Education, CMU is to build and share a transformative higher education experience. Two objectives under this strategic pillar – Objective 1) Invest in creating a transformative experience for each student, and Objective 4) Delivery a quality, affordable education with lifetime professional and personal returns – are directly impacted by technology decisions. CMU needs to continue to leverage technology to develop a case for value in attending college that appeals to both traditional and non-traditional age students.
- Second, technology is a critical component to providing innovative, flexible educational programs that meet the needs of western Colorado and beyond, identified with the *Forming the Future* pillar for Educational Programs. Objective 3 of that pillar – Leverage advances in technology and digital learning to implement high-quality educational experiences – requires aligned technology initiatives and goals to meet this objective.

Information Security

The most critical responsibility of the University's IT Division is the security of its information. How the University protects the data and personal information that students, parents, and alumni entrusted to the institution is extremely important to how they view CMU, and higher education in general. It will, in part, shape the narrative around the institution's pillar for Promoting and Enhancing the Value of Higher Education. The emergence of the data fabrics trend and AI will strengthen advancements in this area.

Cybercriminals are a persistent threat to institutions of higher education, with business applications that contain personal and financial information a top target. The average per-record-cost of a data breach is \$165,¹² with Education having the highest number of reported malware encounters among all industries.¹³ As such, advancing the University's

¹² IBM Security, Cost of a Data Breach Report 2023. The average cost-per-record is across all industries.

¹³ Microsoft Security Intelligence, <https://www.microsoft.com/en-us/wdsi/threats>, Education represented 79.7% of the reported enterprise malware device encounters in the last 30 days (Aug 1, 2023).

Information Security Program continues to be a top priority, and Table 1 summarizes the IT initiatives and goals associated with this area.

Table 1

Initiative 1: Advance the University's information security program and IT governance structures to manage regulatory compliance and cybersecurity risk.	
IT Goals	Aligned Strategic Plan Pillar [Objective]
Goal 1A: Expand the University's information security awareness programs to protect individuals and the institution.	Educational Programs [3] Value of Higher Education [2] Employees [1] [4] Belonging [2] [5]
Goal 1B: Modernize Identity and Access Management (IdAM) solutions with the advent of emerging technologies.	Educational Programs [3] Collaboration and Innovation [1] Employees [4] Belonging [5]
Goal 1C: Leverage the University's information security scorecard to enhance information security controls and reduce the organization's cyber risk exposure.	Value of Higher Education [2] Employees [1] [4] Belonging [5]
Goal 1D: Develop protocols and procedures to evaluate the effectiveness of implemented information security controls.	Value of Higher Education [2] Employees [1] [4] Belonging [5]

The University's ongoing investments in this area protect the institution's networks and information systems from cybercriminals. However, the number and diversity of personal devices that end users utilize to connect to the University's network and information systems have been identified as the institution's biggest cyber target and highest cybersecurity risk the past two years.¹⁴

IT governance controls, such as the University's adoption of its Data Protection Policy in 2023, have already started to increase awareness of the ramifications of mishandling data and to increase awareness among data stewards of their responsibilities to protect data and information systems, but more user awareness on information security principles and cyber risks is needed. Information Technology will continue its work to increase student and employee awareness of cyber threats and what end users can do to protect themselves and the University.

¹⁴ This is true nationally as well, with 74% of all data breaches including a human element, with social engineering, miscellaneous errors (e.g., publishing errors, mis-delivery) and system intrusion representing 76% of data breaches in Education. Source: Verizon's 2023 Data Breach Investigations Report. Statistics from the reports Summary of Findings, Page 4, and Educational Services, Page 54.

Moreover, CMU has established identity, authentication, and access management protocols in place as well as industry standard technical controls to safeguard its network and information systems. The University prioritizes resources for technical controls as its front-line defense against cyber-attacks and to protect information systems and institutional data, and advancements continue to be made on all cyber security fronts. However, the University must continue to remain vigilant in these areas as well as employ more automated tools and mechanisms to support alerts and analysis of cyber events, and continually assess the effectiveness of information security controls to determine the extent to which the controls and alerts are operating as intended to meet established information security requirements.

The risk of financial loss due to a data breach is a constant threat to the University, requiring the institution to take a risk-based approach to its operations and financial investments. By continuing to develop a robust information security program – information security awareness, administrative and technical controls, and assessment of the effectiveness of those controls –CMU will limit the risk of financial loss due to data breach recovery costs and/or the loss of future revenue due to reputation damage.

Instructional Technology and Student Engagement

Technologies that support instruction and student engagement, including immersive learning environments, are essential to the University’s educational mission. Instructional modalities –in-person, online, and hybrid–and their many nuanced content delivery modes (i.e., Hyflex, online synchronous, blended, etc.), must be evaluated to meet students where they prefer to learn, with competition high for a declining number of traditional college-aged students who pose questions around the value of higher education.

The instructional technology supporting in-person classes is still fundamental to the University’s core business – teaching and learning. However, CMU must continue to adapt to student needs to stay relevant in higher education as student preferences shift to online and hybrid course delivery modes as well as to ensure student engagement in curricular, cocurricular, and extracurricular activities.

The quality of courses for all delivery modes as part of the student experience cannot be underestimated. It is critical to the student’s success and the success of the University. As such, it is important for the University to stay committed to high-quality teaching and learning environments and continue to invest in student engagement initiatives. In collaboration with faculty members serving on the Academic Technology Advisory Council, IT has continually invested in the advancement of instruction and directs its financial resources where the institution most effectively impacts students. To be successful, the University must first find a common definition of instructional modalities and align the ongoing commitment to technology around the institution’s *Forming the Future* Strategic Plan and address funding requirements. Table 2 summarizes the IT initiatives and goals supporting the Educational Programs pillar.

Table 2

Initiative 2: Advance learning environments and the student experience in support of the 21st century teacher/learner.	
IT Goals	Aligned Strategic Plan Pillar [Objective]
Goal 2A: Evolve instructional technology standards to provide innovative teaching and learning environments in support of the University's mission.	Educational Programs [3] Collaboration and Innovation [1] Value of Higher Education [1] [4] Belonging [4]
Goal 2B: Create opportunities for every student to own a laptop with the performance to support the degree they are seeking.	Educational Programs [2] Collaboration and Innovation [1] [4] Value of Higher Education [1] [4] Belonging [5]
Goal 2C: Deploy technology to enhance student engagement and support student success initiatives.	Educational Programs [3] Value of Higher Education [1] Belonging [1][2] [3] [4] [5]
Goal 2D: Support the growth of distance and online education by aiding academic programs with leveraging advances in technology.	Educational Programs [3] Collaboration and Innovation [1] Value of Higher Education [1] [4] Belonging [4]

Chasing too many course delivery modes without strategic direction runs the risk of negatively affecting the overall quality of education, students' perceptions of the institution, and impact on the institution's bottom line. According to a recent EDUCAUSE research report, 53% of students and faculty preferred in-person learning and teaching in 2023, down from 70% and 73% respectively pre-pandemic in 2019.¹⁵ The report goes on to show that student preferences for online instruction are dependent on the types of learning activity they are engaged in. For example, 71% of students engaging in lab or interactive work prefer to be on-site versus 29% preferring online, where most students in the study prefer online for an individual activity such as research.

Student preferences for instructor lecture and class discussion are more evenly split between in-person (59%) and online (41%) instructional modalities. Perhaps most interesting is that student satisfaction in hybrid courses is determined by their structure, and whether the student has a choice to engage in a specific course learning activity on-site or online. Students with a choice in how they engage in course activities are more satisfied with a course.

Student engagement continues to be a key indicator of student success. How students interact with the campus in and out of the classroom through faculty, peers, and technology has an impact on student retention and enrollment. Programs across the nation

¹⁵ EDUCAUSE, Educational Technology Research in Higher Education: New Considerations and Evolving Goals by Sean Burn, October 27, 2023. Changes in Student and Faculty Learning Modality Preferences.

have found that creating a strong sense of community, where students build connections with one another and with the college, contributes to college completion rates. This aligns with *Forming the Future's* pillar to build a culture that supports a Student Sense of Belonging at the University.

In another study, a 2023 meta-analysis of factors that influence student engagement identified fourteen factors affecting students' learning participation that included a student's positive emotion, student partnerships in class, and support of learning resources that includes classroom technology.¹⁶ The campus community, a student's surroundings, and learning environments strongly affect student engagement.

Digital Transformation

For more than a decade the University has been optimizing business processes to digitally transform. Until recently, the transformation journey has been a series of smaller projects to either automate processes or add functionality by adding point solutions to enhance its core Enterprise Resource Planning (ERP) systems in HR, Finance and Student Information. However, the University community increasingly understands that a complete digital transformation is more than digitizing and automating processes and adding point solutions.

To accelerate CMU's digital transformation process, it is important that the institution's core systems and enterprise applications evolve so that CMU can keep pace with business capability requirements and operational demands, as well as position the University to leverage the latest in technology advancement. Facilitating CMU's transition is a \$3.2 million award from the State of Colorado in FY24 for an ERP Modernization project.

Supporting the *Forming the Future* pillar to Recruit and Retain Employees, the grant funds, in part, the implementation of HR and Finance Software as a Service (SaaS) applications. With this project, CMU looks to develop a composable business-application strategy, innovate business practices to better serve students and employees, drive efficiency, and lower the cost of degree attainment. SaaS application vendors release new features and updates at a faster pace than on-premise solutions or other cloud-delivery models. SaaS applications are designed for agility. Table 3 summarizes the IT initiatives and goals associated with this area.

¹⁶ Li J, Xue E. Dynamic Interaction between Student Learning Behaviour and Learning Environment: Meta-Analysis of Student Engagement and Its Influencing Factors. *Behav Sci (Basel)*. 2023 Jan 9;13(1):59. doi: 10.3390/bs13010059. PMID: 36661631; PMCID: PMC9855184.

Table 3

Initiative 3: Through a cloud-smart approach, replace legacy applications to modernize the University's operations for continuous delivery of new business capabilities and innovation.	
IT Goals	Aligned Strategic Plan Pillar [Objective]
Goal 3A: Implement modern Software-as-a-Service HR and Finance systems to meet business agility requirements.	Educational Programs [1] Collaboration and Innovation [1] [4] Value of Higher Education [4] Employees [1] [4]
Goal 3B: Transform student and employee experiences through increased personalization, automation, and self-service.	Collaboration and Innovation [1] Employees [1] [3] Belonging [1] [2]
Goal 3C: Reskill Information Technology and business unit staff to support continuous delivery of modern SaaS applications.	Collaboration and Innovation [1][3] Employees [3] [4]

Through a cloud-smart approach, CMU's ERP Modernization project will reduce the time and resources needed to replace its legacy Banner applications with modern operations for continuous delivery of the newest business capabilities and technologies. HR systems with the latest advances in user interface design and capabilities greatly enhance employee onboarding experience through built-in features such as tracking employee coverage and then using that data to calculate appropriate compensation, in addition to more robust performance management features.

Further, current IT staffing levels have been sustainable, in part, due to the adoption of cloud delivered and SaaS applications. As SaaS applications are leveraged, the University can reduce its technical debt of maintaining legacy administrative and business applications that are unsustainable technologically and financially. IT staff resources can be repurposed to improve data management processes and deliver value-added projects.

Data Management and Analytics

A modern data management strategy supports CMU's finances by reducing the risk of financial loss, optimizing operational processes, and measuring institutional performance. It also supports the above-mentioned ERP Modernization project and the development of a composable business-application strategy. Table 4 summarizes the IT initiatives and goals associated with this area.

Table 4

Initiative 4: Develop a modern data management and analytics strategy to enable better use of the University's data assets for enhanced decision making across administrative and educational functions.	
IT Goals	Aligned Strategic Plan Pillar [Objective]
Goal 4A: Develop a data fabric to enable better data sharing and manage the flow of data from business applications/data sources and out to data consumers—applications, processes, and business units.	Educational Programs [1][3][5] Collaboration and Innovation [1] [2] [3] Value of Higher Education [1] [2] [3] Employees [2] Belonging [2] [4] [5]
Goal 4B: Implement sustainable integration methods to support the University's hybrid cloud environment and composable business application strategy.	Collaboration and Innovation [1] [2] Belonging [4] [5]
Goal 4C: Deploy a data store for analytics platform with the capability to accelerate the development of data models, improve data governance, and enable data-informed decision making across the University.	Educational Programs [1][3][5] Collaboration and Innovation [1] [2] [3] Value of Higher Education [1] [2] [3] [4] Employees [2] Belonging [2] [4] [5]

By implementing a modern data management strategy built on cloud-delivered platforms, CMU can address data management, integrations and analytics as well as provide core technical capabilities (i.e., support for data governance, metadata management, and artificial intelligence). Technology solutions that are part of the strategy include a data hub platform, Integration Platform as a Service (IPaaS) tools, and a data store for analytic workloads as part of the data fabric implementation.

A data store for analytic workloads connects and transforms data from department files and core systems (i.e., HR, Finance, Student, Recruitment, and Learning Management Systems, etc.) into models where analytics can be used to support targeted recruitment and retention initiatives. For example, CMU can have a more proactive student intervention to improve retention and graduation rates by combining data points from CRM data, learning management systems, and degree planning tools, along with data from the student information system and attendance/engagement activity. Analytics also can promote CMU's strengths and demonstrate the value of obtaining a technical or industry credential or college degree relevant to student career paths and economic demands. These examples support *Forming the Future's* pillars of Student Sense of Belonging and Educational Programs. Yet another example illustrating a link to all five pillars of the Strategic Plan, analytics can be used to identify new revenue streams that can support new potential academic programs and auxiliary business models.

Modernizing the IT Service Portfolio

Technology continues to play an integral role in the success of the institution, and it is important that users are comfortable with technology through quality, intuitive experiences. To meet the increasing demands on technology and customer service, it is necessary that the University modernize its IT Service Portfolio and infrastructure to align with the business needs of the institution. In part, this requires developing an IT Service Management (ITSM) strategy, and Table 5 summarizes the associated IT initiative and goals which support all the *Forming the Future* pillars, most relevant being Promoting and Enhancing the Value of Higher Education and Student Sense of Belonging.

Table 5

Initiative 5: Modernize how Information Technology creates and delivers services to its customers and provides business value to the University.	
IT Goals	Aligned Strategic Plan Pillar [Objective]
Goal 5A: Deliver a holistic approach to IT service management through innovation and our shared values to effectively support students, faculty, and staff.	Educational Programs [2] [3] [5] Collaboration and Innovation [1] Value of Higher Education [1] [4] Employees [1] [4] Belonging [1] [2] [5]
Goal 5B: Enable secure, reliable access to online services regardless of physical location and time of day.	Educational Programs [1] [2] [3] Collaboration and Innovation [1] [4] Value of Higher Education [1] [4] Employees [1] [4] Belonging [2] [4]
Goal 5C: Enable virtual collaboration solutions that support on-campus and remote work.	Educational Programs [1] [2] [3] Collaboration and Innovation [1] [4] Value of Higher Education [1] [4] Employees [1] [4] Belonging [4]
Goal 5D: Further develop the University's hybrid cloud environment through hyperconverged infrastructure and public, private cloud services.	Educational Programs [1] [3] [5] Collaboration and Innovation [4] Value of Higher Education [1] [4] Employees [1] [4]

Positive user interactions encourage adoption of the tools and reinforce their ongoing application to various projects. In the case of students, their perception of CMU's technology begins with the application process and continues to be shaped as they use the available technologies going forward. Positive or negative experiences can be key factors in their perceptions of the institution, which by extension, influence enrollments. In the highly competitive market for traditional college-aged students who have questions around the value of higher education, technology is a consideration.

IT Service Management (ITSM) is a set of organizational capabilities that support business outcomes that enhance customer services. Inherent in ITSM is an understanding that value is based on the perception of the user or customer, be they internal or external (e.g., student, parent, alumni). The frameworks emphasize the importance of service relationships and how IT services ensure access to technology, deliver support, and manage resources effectively and efficiently. Currently there are several nationally-recognized ITSM frameworks and complementary tools on the market that facilitate creation of strategic direction by institutions.

To meet this modern approach to service delivery, the University's technology infrastructure also must change. High-level performance and reliability of the network will be critical to the user experience moving forward. Further, the importance of private data centers has vastly changed over the last 10 years with the dominance of cloud services. Over the next 5-10 years, the profile and importance of the data center will continue to morph to meet the growing trend of cloud and hybrid cloud environments in higher education. Continued investments in campus infrastructure are critical to support its mission.

Appendix A— 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 9,000 students 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 – CMU Tech, formerly 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 to 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.

Appendix B— 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 Part 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.

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 development of 2020 *Technology Master Plan* follows the decisions to extend the 2020 *Strategic Plan*.

CMU Board of Trustees approved the 2023- 2027 *Forming the Future* Strategic Plan on May 19, 2023. The University's *Technology Master Plan* has been historically updated every four years following the following updates to the Strategic Plan. The 2024 *Technology Master Plan* establishes five strategic IT initiatives to support the University in meeting the *Forming the Future* Strategic Plan pillars and objectives.

Appendix C— 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 2020 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.

Appendix D—Update to 2020 IT Initiatives

2020 Initiative 1: Improve business processes and institutional decision making through the use of technology.

Goal 1A (2020): Improve business analytics, reporting and practices to support management decision-making processes.

Alignment: 2020 Institutional Goal 3, Objective (O)3C-Strategy (S)1

Accomplishments:

The University started implementing Ellucian's Operation Data Store (ODS) and IBM Cognos Business Intelligence Reporting software to improve institutional reporting in 2016, and the development of ODS and Cognos reports has continued since that time. The ODS and Cognos solution enables business areas to create reports and perform analysis on Banner reporting views while improving data security through access control policies for ODS data and integrity, insuring consistency of transactional reporting for the institution. By 2019, all reports previously developed through Crystal Reports were converted to Cognos.

Since 2019, the ODS database has been updated several times, several Banner tables have been added to the ODS, and numerous Cognos reports have been created by business units and Information Technology to expand its use. In 2021, Information Technology created a process to snapshot financial aid data in the ODS for Institutional Research and Financial Aid. The weekly snapshot includes information about who has applied for financial aid, who has been awarded aid, when it was awarded, the amount awarded, the type of award, and the status of any financial aid requirements. Institutional Research and Financial Aid combined this information with enrollment information to determine how effective CMU's various types of financial aid are in attracting and retaining students.

In addition, the University embarked on a ground-breaking effort in 2018 when it contracted with Degree Analytics to use its unstructured wireless logs and analyze how students engage with departments and programs across campus. The program provides the university student attendance and behavioral metrics to enhance early alert and student success programs. In addition, the Degree Analytics program has been used to look at facility use for campus planning and special use cases such as the pandemic response effort to de-densify campus through wireless data, which proactively provided students with information about space occupancy so they could avoid high-use areas. CMU is currently using Degree Analytics to help determine which groups of students carry a laptop to class and how students use computer labs, as another example.

Over the past twelve months, the University has renewed interest in expanding its data analytics capabilities and improving data-informed decision making. A data management strategy prospectus that describes the financial benefits of

implementing a modern data management strategy built on a cloud-delivered platform was developed in 2023. This led to a decision to release a Data Management and Data Store for Analytics RFP in the fall of 2023 to select a vendor to assist with the development of a comprehensive data management strategy to expand the University's reporting and analytics capabilities with data models and analytical tools, and data governance controls to improve data security, quality, and consistency for institutional decision making.

Goal 1B (2020): Implement web-based administrative platforms and modernize the University's Enterprise Resource Planning (ERP) systems to improve services.

Alignment: 2020 Institutional Goal 3, (O3C-S1)

Accomplishments:

The development of a digital transformation and Enterprise Resource Planning (ERP) modernization strategy to advance the University's core administrative systems has been a priority over the past four years. Starting in 2019, the University completed Ellucian's Strategic Alignment Plan engagement. Through this engagement, CMU evaluated its overall use of Banner ERP—HR, Finance and Student Information Systems—and other solutions licensed through Ellucian. This work was then placed on hold as the University managed the disruption caused by the pandemic of 2020. Moreover, in 2020 Ellucian informed CMU that it would not renew its Application Managed Services contract past its end date of August 2022. The University had become reliant on Ellucian's AMS services for the past seven years to augment its professional staff and provide Oracle database administration (DBA) and software maintenance and upgrades of its Ellucian licensed applications running in the University's datacenter.

In 2021, the University submitted a capital IT funding request to the State to modernize its ERP systems. CMU's \$4,598,000 ERP Modernization project request for FY2022-23 included upgrading its HR/Finance systems, migrating its Student Information System to cloud services, and implementing a comprehensive data management strategy to develop a composable business application strategy. With this project, the University would evaluate the move to more modern HR and Finance systems to accelerate its digital transformation journey and migrate its Banner Student Information System to Ellucian's Managed Cloud (private cloud) running on Amazon Web Services, a Strategic Alignment Plan recommendation to complete their 'Banner Path 2 Modernization' option. Moving to Ellucian's full SaaS ERP offering was not an option in 2021 due to Banner COF customizations, but with AMS support ending, the University had to position itself to support its Banner Student Information System for at least the near future.

However, the University's FY2022-23 ERP Modernization project request was not awarded by the State. With the University's AMS contract with Ellucian ending in August 2022, CMU faced the decision to re-hire professional staff, including an

Oracle Database Administrator, and purchase replacement Banner application and database servers, or fund the migration to Banner Managed Cloud out of institutional dollars. The University contracted for Ellucian's Banner Path 2 Modernization starting January 2022 and commenced moving to Ellucian's Managed Cloud. Under this contract, Ellucian agreed to credit the remainder of CMU's AMS service contract to offset the cost of Managed Cloud and support the University with AMS services for up to 12 months while the migration to Managed Cloud is performed.

Over 2022, the University migrated its Banner ERP—HR/Finance/Student—from servers on-premises to Ellucian's Managed Cloud (private cloud) running on Amazon Web Services, going live the last week of February 2023. In addition to the core Banner modules, the migration covered all Ellucian licensed products: Banner Document Management suite, Operational Data Store/Business Intelligence, IBM Cognos report writer, Degree Works, and Degree Works Transfer Equivalency. The Managed Cloud project is the largest Information Technology project that the Banner group has accomplished since Banner was implemented in the early 1990s. The migration to Managed Cloud required significant changes in how Information Technology maintains its Banner environment, including access control, change management and security requirements. To meet these requirements, Information Technology spent a year modifying scripts and nightly-scheduled processes and re-implementing every integration with Banner to make them "cloud ready." Moreover, Information Technology took this opportunity to clean up processes and better align the management of its Banner environment with Ellucian's best practices. Finally, to help ensure the success of the project, Information Technology coordinated Banner application and business process testing with functional departments.

In addition to the ERP initiative, other administrative system implementations were accomplished over the past four years such as: Ellucian's Ethos Integration platform, JAGGAER's e-Procurement suite, and Modern Campus' (DIGARC) student course scheduling product. After placing the Ethos Integration platform into production, Information Technology developed the APIs (application programming interfaces) to receive vendor update information from JAGGAER and make Ethos calls to update Banner. The e-Procurement project was implemented to manage the entire procurement cycle from requisitioning to payment processing with the goal of streamlining procurement through automation, eliminating paper processes, and improving spend visibility through analytics, while driving costs down by better leveraging negotiated price agreements for online purchases. Last, Information Technology supported the Integrated Resources for Information and Solutions and Registrar's Office project to procure and implement Modern Campus to improve the student registration experience.

At the same time Information Technology worked on its 'lift and shift' project to move its Banner ERP to Ellucian Managed Cloud, the University resubmitted its

State Capital IT Project funding request to modernize the University's Enterprise Resource Planning (ERP) system as part of CMU's ongoing digital transformation initiative for FY2023-24. The project narrative and costs were revised to remove the first phase of moving Banner to Ellucian Managed Cloud. The ERP Modernization Project request for \$3.29M (with an estimated overall project cost of \$3.66M) would 1) implement cloud software-as-a-service (SaaS) HR and Finance systems, and 2) develop a comprehensive data management and data integration strategy as part of the University's composable ERP Strategy to develop an adaptive architecture to compose, recompose and extend application to ensure the future demands of the institution can be met, limiting vendor lock-in. The State awarded CMU FY2023-24 ERP Modernization project request and the project was kicked off July 1, 2023, with the development of its comprehensive data management strategy.

Goal 1C (2020): Manage and automate student-centric processes through the development of Customer Relationship Management (CRM) technologies.

Alignment: 2020 Institutional Goal 1, (O1A-S1 & 2, O1E); Goal 2, (O2A, O2B); and Goal 3, (O3C-S1)

Accomplishments:

CMU was an early adopter of using a Student Success CRM product when implementing Ellucian's CRM Advise in 2015, one year after the institution went live with CRM Recruit for Admissions. In 2022, the University's Admissions and Integrated Resources for Information and Solutions (IRIS) adopted Slate as its recruitment and student success CRMs to replace the Ellucian products. The implementation of Slate began early 2022 with recruitment, followed by student success the following year. Following the adoption of Slate, a complex data integration project ensued to using CMU's new Integration Platform as a Service (IPaaS) product, Boomi.

Information Technology built an IPaaS integration to import admitted student and application data from Slate to Banner Student Information System. The development of an iPaaS solution was a strategic initiative to dramatically reduce the number of hours required each year for custom code development as the university continues to leverage cloud-based applications. Further, CMU is a leader in the use of IPaaS with Ellucian's Ethos integration platform. The Boomi Slate to Banner connectors were the first fully packaged iPaaS processes developed by Information Technology and can process hundreds of admitted students per run. The Boomi process returns a file for Slate to import that includes student identification number and application sequence number. Last, Slate to Banner integrations continue to be developed for admissions and student success data, as well as other Slate integrations which have been built to import documents from Slate into Xtender, Banner Document Management.

In addition to changes with admissions and student success CRMs, the University's Foundation has recently moved to Salesforce for its CRM product. The University will continue to enhance its CRM solutions as a vital part of every business as it cultivates future, current, and former students.

Goal 1D (2020): Expand the use of Human Resource Management Systems.

Alignment: 2020 Institutional Goal 1, (O1B, O1C, O1E)

Accomplishments:

CMU continues to focus on improving employee recruitment processes and the applications used to streamline steps for employee onboarding. Between 2021 and 2023, the employee check-in process has been digitized and subsequently improved to streamline the entire process. The University uses Banner and Cornerstone as its HR and applicant tracking systems respectively. In 2021, an electronic form was created with workflows to gather required information and approvals. Human Resources initiates the form upon hire that auto populates with data from Banner. The electronic form then routes to the employee's supervisor who provides key and required information to onboard their employee. Moreover, scripts were developed to automatically kickoff processes to create network and system accounts and access, MAVcards, and building and office keys so employees would have what they need to be successful on the first day of employment.

In addition, CMU amended its Desire2Learn agreement to add Brightspace Core with Upskilling for EDU platform for Human Resources. This Desire2Learn product adds a professional development environment for staff and faculty training. The creation of professional development content is ongoing.

As CMU continues its digital transformation process, it is important that the institution's core HR and Finance systems transform to enable the University to continuously evolve and keep pace with business capability requirements and operational demands as well as position the University to leverage the latest in technology advancement. The University will continue to expand its human resource management system with its ERP Modernization project as it looks to advance its Human Resource Capital Management system with the move to Software as a Service applications as part of its composable business-application strategy to innovate business practices to better serve students and employees.

2020 Initiative 2: Advance information security programs and business continuity planning.

Goal 2A (2020): Expand information security awareness programs.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

The University has taken numerous steps towards the *2020 Technology Master Plan* goal to improve its information security program and increase information security awareness among students and employees to protect the privacy of students and prevent the loss of data. It is widely accepted that human error is the predominant cause of data loss, with 74% of all data breaches including a human element, and social engineering, miscellaneous errors (e.g., publishing errors, mis-delivery) and system intrusion representing 76% of data breaches in Education.¹⁷ As such, the University continues to emphasize information security awareness as a large part of its information security program. Following are examples of major University initiatives to improve data security and increase information security awareness.

First, Information Technology completed a two-year (2021-2022) audit of where Personally Identifiable Information (PII) data is gathered, shared, and stored by departments. A PII Questionnaire was sent out to fifteen departments for the purpose of determining what and where confidential information is stored as a part of normal business operations, if the data is shared, and for how long the data is retained. The information was analyzed and follow-up discussions with each department occurred to improve data handling protocols, adjust business practices and/or add appropriate controls, and promote awareness of information security best practices. The PII Questionnaire responses showed a need to take a closer look at certain university processes for gathering and storing confidential information within the organization and transferring confidential data to external entities to reduce cybersecurity risks.

Second, as an outcome of the PII Questionnaire and analysis, the University revisited its 2017 Data Protection Plan and updated the document to a policy. In October 2023, CMU Board of Trustees adopted the Data Protection Policy to help strengthen the University's information security program, the protection of institutional data, and the information systems that the data resides on through increased awareness and responsibility among data stewards. The Data Protection Policy is a cornerstone of the University's Information Security Program. Through increased employee awareness and control requirements the Data Protection Policy helps ensure the security and confidentiality of student and employee information.

Third, the University implemented multifactor authentication (MFA) for Microsoft 365 (M365) accounts. Improving employee awareness of phishing emails and social engineering techniques has been a high priority for several years. However, there continued to be a high number of students and employees with compromised accounts and shared network credentials. In 2022, Information Technology deployed Multifactor Authentication (MFA) for web email and other Office 365

¹⁷ Verizon's 2023 Data Breach Investigations Report. Statistics from the reports Summary of Findings, Page 4, and Educational Services, Page 54

applications such as OneDrive, Teams, and Outlook. In the year following CMU's implementation of MFA for M365, there were 85% fewer compromised accounts than the previous year.¹⁸ Moreover, the University expanded MFA protections to Banner and other business web applications in April 2023 to help protect personal identifiable information.

Fourth, the University made a substantial investment in Microsoft Defender licensing in 2023. The additional information security funding allowed the University to transition to Microsoft A5 licensing. This provided a powerful security platform known as Microsoft Defender within the University's M365 environment. The additional funding also allowed each computer and server to be protected by a local Microsoft Defender for Endpoint Plan 2 client which is tightly integrated with Microsoft Defender within M365. This combination provides highly effective and immediate alerts from endpoints and M365 accounts and services based on logged activity in real time. Among other benefits, the upgrade to Microsoft Defender A5 licenses provided additional tools for simulated email phishing campaigns that safely train users to be aware of the dangers of social engineering attacks that they face daily. Students, staff, and faculty that fall for simulated attacks are automatically assigned information security awareness training provided with the A5 license. To reinforce the importance of recognizing phishing scams, training is logged and repeat offenders are automatically assigned additional training.

Goal 2B (2020): Update Information Technology policies and security practices with a focus on addressing risks associated with mobile devices and cloud services.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

With the prevalence of mobile- and cloud-computing, more and more institutional data is stored and processed outside of the University's data center and its fortified network perimeter. In 2023, over 80% of the University's business applications are cloud delivered and nearly all staff and faculty use some form of mobile computing. Moreover, with the high adoption rate of cloud services, Information Technology is no longer the only administrator of applications with the authority to authorize access and grant permissions to institutional data.

To keep up with changes in technology platforms and their associated security risks, Information Technology has leveraged National Institute of Standards and Technology (NIST) published information security guidelines to help measure the completeness of the University's administrative and technical information security controls. In 2022, the University adopted the National Institute of Standards and

¹⁸ Data from the university's compromised account report. CMU IT implemented multifactor authentication for M365 in February 2022. There were 9 compromised accounts logged from March 2022-February 2023 compared to 61 logged compromised accounts between March 2021-February 2022.

Technology-Cybersecurity Framework (NIST-CSF) to guide its information security program. The NIST-CSF framework is organized by five key functions—Identify, Protect, Detect, Respond, and Recover—and maps to NIST administrative and technical security controls broken down into groups or categories of cybersecurity outcomes. The NIST-CSF has been widely adopted across many industries due to its business-friendly approach to helping organizations improve their cybersecurity programs through a risk-based approach, and Information Technology used the NIST-CSF to perform an annual review of its information security program that includes an annual information security/cyber risk assessment. An information security scorecard was developed, and a rubric was created to perform an annual information security assessment and controls gap analysis to identify areas to prioritize investments in staff time and financial resources to meet the University’s desired information security outcomes.

In addition, following NIST security control standards supports compliance with state and federal laws and regulations. For example, NIST Special Publication 800-53, *Security and Privacy Controls for Information Systems and Organizations*, is referenced by Federal Student Aid as appropriate industry standards and best practices to be followed to meet cybersecurity rules under the Gramm-Leach-Bliley Act (GLBA) and the Federal Trade Commission Safeguards Rule for nonbanking financial institutions like institutions of higher education.

Further, privacy laws such as European Union’s General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA) have paved the way for other states to adopt or introduce data privacy laws to protect Personally Identifiable Information (PII) collected by government entities and corporations alike. June 30, 2021, Colorado’s House Bill 21-111 was enacted to amend C.R.S. 24-37.5-122 requiring a study be convened to determine how PII is stored by State entities and determine if it can be centrally managed and protected. Ultimately, the State of Colorado and its consultants determined that statewide centralization of PII was not feasible and does not substantially improve the protection of sensitive data.

At the same time the State convened its PII study, CMU engaged its business and academic departments to identify how PII is collected, stored, and used across the university. Between 2021-2023, Information Technology circulated a PII Questionnaire and analyzed its findings. The PII Questionnaire responses showed a need to take a closer look at certain university processes for gathering and storing confidential information within the organization and transferring confidential data to external entities to reduce cybersecurity risks. Following the analysis of how PII and other sensitive information is handled across university departments, CMU Board of Trustees adopted a Data Protection Policy in October 2023. The Data Protection Policy establishes a data governance structure for the University by 1) defining roles and responsibilities for data stewardship; 2) defining classifications for university data based on levels of sensitivity; and 3) outlining guiding principles for properly protecting University data. The Policy

supports the University's compliance with state and federal laws and regulations. The Policy was originally developed as a plan to protect data in 2017 with the prevalence of mobile and cloud computing. The Policy still addresses the security of mobile devices and cloud services through identity and access management, risk management, and data management principles.

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. These protocols align with the Data Protection Policy data management principles. The Information Technology Department assesses the risks of each technology project at onset to ensure the necessary information security controls are implemented by cloud vendors. Cloud vendors and software vendors that leverage cloud infrastructure must demonstrate that they have safeguards in place to control risks and undergo their own annual risk assessments.

For example, the Ellucian Managed Cloud service and service level agreements were heavily examined prior to the University migrating its Student Information System and Banner ERP systems to the cloud. The review determined that Ellucian Managed Cloud offering uses Amazon Web Service (AWS) cloud infrastructure, and its information security program is ISO 27001 certified and undergoes annual audits. Moreover, Ellucian retains a third-party firm to conduct annual Service Organizations Control (SOC) SOC 1 and SOC 2 Type II audits. It was also determined that Ellucian's Managed Cloud services had the necessary administrative and technical security controls in place to protect the University's most sensitive information such as AES-256 volume level encryption of databases, and documented change management policies and procedures for making system and software changes.

In addition, several advanced network security features were implemented with the State funded Capital IT Network Security and Resiliency Project to reduce the risk of mobile devices impacting and or infecting the campus network. (See Goal 2C for more information on the Network Security and Resiliency Project) Fall 2019, CMU implemented Aruba ClearPass to improve the onboarding of personal clients onto the wireless network and simplify guest wireless access in residence halls and across campus. At that time, Information Technology configured Aruba ClearPass to identify client types on the network and set up network policies to manage devices and enforce access through Aruba's Dynamic Port Segmentation policies. Dynamic Port Segmentation provides complete visibility of what and who is on the University network and allows access to the network according to network security policy, eliminating possible points of unauthorized access. With the Network Security and Resiliency Project, Aruba's ClearPass and Dynamic Port Segmentation security policies were extended from just wireless to include wired device ports. For example, CMU registered, Internet of things (IoT), untrusted, and guest devices are dynamically segmented by virtual LAN to protect

systems, applications, and other devices on the University's network from being affected by a compromised device during a malicious attack.

Last, administrative protocols were developed, and the IT Contract Provisions were modified to address contractor access to cloud applications which are often managed by business units and not centrally through Information Technology. This need arose from requests for the University to allow access to systems containing sensitive data, and in some cases CMU email addresses, to contracted third party employees. To comply with existing security and licensing requirements, the third-party employees are expected to agree to and sign a specialized version of the CMU IT Provisions that outlines their responsibilities as a user of a CMU system. If a third-party employee requires additional functionality, including a CMU email address or other services requiring licensing, the individual must be set up as a contract employee with the CMU Human Resources department and be processed as a Check-In by Human Resources. Contract employees must agree to network account terms prior to an account being created for their use. This obligates the individual to existing CMU security requirements. In addition, the protocols and IT Provisions require the third-party company to provide notice when an employee has left their service and no longer requires their access to CMU systems. Third-party employees may not reuse or share CMU accounts and the credentials must be protected until CMU has disabled the account. Last, protocols were established internally to ensure that no one University data custodian or administrator of information systems may create a system account that cannot be managed and audited by Information Technology.

Goal 2C (2020): Expand business continuity and disaster recovery planning preparations and testing.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

CMU has completed several projects to improve its business continuity and disaster recovery preparedness. Achievements in the prior four years were towards disaster recovery planning primarily focused on data storage, data backups and alternate site preparations due the constant threat of ransomware attacks. Efforts were also placed on improving network uptime, but the network still had several potential critical points of failure that needed to be addressed. Exacerbating the risk of network downtime is the mere fact that most of the University's enterprise applications are now hosted outside of its data centers and the demand on network connectivity is at an all-time high supporting bring-your-own device (BYOD) and IoT (internet of things) devices. Today, 80% of CMU enterprise applications are cloud delivered and last spring there were over 17,000 devices registered on the campus network, not including the hundreds of visitor wireless devices that connect to the campus wireless network each month. For these reasons, over the last four years the University has focused on upgrading its network so critical to

operations and the student experience by replacing its large-scale modular core switch, adding a core switch redundancy in the secondary datacenter, and upgrading the local area network (LAN) backbone between campus buildings to provide redundant links.

In 2021, CMU was awarded \$2.2M State's Capital IT Project award of University's Network Security and Resiliency Project for FY22. The project consisted of 1) upgrading its core network switch and adding redundant top-of-rack 40 Gigabit Ethernet (GbE) switches to increase connectivity to virtualized server environments; 2) upgrading the main campus local area network backbone to 10 GbE with redundant links to most buildings; and 3) replacing edge switches in residence halls to upgrade all device ports to 1 GbE with advanced features to support dynamic port segmentation for increased personal device security.

Prior to the Network Security and Resiliency Project, the University's Local Area Network (LAN) was a modified star topology with a partial mesh comprised mainly of a 1GbE (Gigabit Ethernet) backbone to buildings with 100Mb (Megabit) connections to endpoints. With the Project, a pair of Aruba VSX core network switches were installed in the primary and secondary data centers with redundant 40 GbE links configured between the core network switches. The new core networks switches provide 10 GbE ports for redundant building local area network (LAN) backbone connections. In addition, a pair of high-performance 40 GbE top-of-rack switches were installed in each data center to manage network traffic between the VSX core switches, virtualized servers, and mobility controllers. The top-of-rack switches are configured with redundant 40 GbE uplink connections to the VSX core network switches and redundant 10 GbE connections to servers and mobility controllers to support the University's wired and wireless infrastructure.

Moreover, in addition to adding redundant network links to buildings and adding redundant equipment in the data centers to improve automatic failover in the event a piece of equipment fails, each pair of top-of-rack switches and building switch stack was configured to use Aruba's resilient switch stacking technology to provide redundancy and to handle heavy data traffic loads between systems and building networks, significantly increasing the University's network performance and resiliency and eliminating the potential of a single switch failure taking the entire building network down. These network improvements along with a series of network security advancements (See Goal 2B) were completed with the Network Security and Resiliency Project in 2023.

In 2022, Information Technology renegotiated multiple internet service and wide area networking agreements with two internet service providers to lower telecommunications service charges and substantially increase the overall bandwidth serving the main and remote campuses from 5 Gigabits per second (Gbps) to 10 Gbps. Moreover, the University is now able to balance its internet bandwidth between both providers to improve performance constraints in the event of a provider outage. Further, over a two-year span, Information Technology

dialled in Border Gateway Protocol (BGP) services on both internet circuits to allow dynamic routing between providers for automatic failover between services during an internet provider outage.

In 2023, the University replaced its Fortinet FortiGate security appliances ('firewalls') with FortiGate's latest next-generation firewall technology. The firewall upgrade not only increased network performance, but it enabled the University to take advantage of Fortinet's newest AI-powered security and machine learning capabilities for advanced threat protection. A firewall was installed in both the primary and secondary data centers for redundancy and configured to work with the redundant Aruba core network switches. With this new redundant network configuration, the University is taking full advantage of the firewalls' failover capabilities.

This work culminated in a network environment that could seamlessly failover automatically and eliminate network downtime for students, faculty, and business units. All this hard work paid off Fall 2023 when the primary internet provider for the campus had two lengthy outages due to fiber cuts that went predominantly unnoticed by campus.

CMU continues to take advantage of inherent backup and failover protections of cloud-delivered systems for its enterprise business applications. Cloud providers have capabilities to ensure high availability and resiliency of systems. High availability and resiliency for cloud delivered services is provided by highly redundant hardware systems and sites using clustering, load balancing workloads between redundant systems or clusters and the automatic redistribution of workloads when network or system errors or failures are detected, and automatic backup and recovery of data to alternate cloud data centers.

As an example, the University's Banner ERP and Student Information Systems run on Ellucian's Managed Cloud (private virtual cloud) hosted environment running on Amazon Web Services (AWS). (See Goal 1B for more information on the Ellucian Managed Cloud project). The Managed Cloud environment on AWS infrastructure provides data protection safeguards including backup protocols and system performance and resiliency measures for business continuity requirements.

Last, the Business Continuity and Disaster Recovery Plan was updated with changes made through the Network Security and Resiliency Project, bandwidth and firewall upgrades, and Banner HR, Finance, and Student Information System move to Ellucian's Managed Cloud.

Goal 2D (2020): Improve the process for which the University identifies, assesses, and manages the risks associated with IT systems and projects.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

CMU maintains an Information Security and Incident Response Plan which in part stipulates that the University will assess technology projects for information security risks to ensure the necessary information security controls are implemented with each institutional initiative, and that they are maintained throughout the life of the software or technology system. First, the Plan requires that the University will maintain a process to assess the risks to security and integrity of systems and institutional data at the development of new technology projects and technology system upgrades to verify required information security controls are in place. Second, the Plan requires the University to maintain contract management protocols for reviewing and establishing agreement terms and conditions to ensure service providers, such as providers of Software-as-a-Service or cloud-based services, have the necessary data protections and technological safeguards in place to protect institutional data that the service provider may have access to or may reside outside the University's data center. The Plan is updated each year and is formally submitted to the State every third year. The last major revision of the Plan was submitted to the Colorado Department of Higher Education on June 20, 2022.

In conjunction with the Information Security and Incident Response Plan, Information Technology continues to encourage the use of the IT Project Scoping document to proactively gather information that is vital to the planning and execution of newly submitted technology projects. Technology projects initiated outside of a Request for Proposal solicitation, 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. However, how the University updates risk assessments before making significant changes to systems and software configurations was identified as an area the institution needs to improve during its last Information Security Program review. Information Technology continues to promote use of the IT Project Scoping document to help with consistent vetting of data use with system changes. Further, the institution's formal Information Security Program review process adopted in 2022 includes an annual information risk assessment based on the National Institute of Standards and Technology-Cybersecurity Framework (NIST-CSF). By using the NIST-CSF framework with mapped NIST administrative and technical security controls, the University continually strengthens its information security program and how it managed information security risks (See Goal 2B for more information on the University's adoption of NIST-Cybersecurity Framework).

Last, the University updated its Data Protection Plan to a policy last year. The CMU Board of Trustees approved the University's Data Protection Policy in October 2023 which defines data custodian roles and responsibilities to improve user and data custodian awareness of data protection principles and their responsibilities for protecting sensitive information. One of the Policy's data

protection principles centered on risk management is to identify, assess, and address information security risks at the onset of each technology project that includes a full scope of institutional data. Information Technology is confident, based on current conversations, that the adoption of CMU's Data Protection Policy will strengthen the University's information security program, the protection of institutional data, and the information systems that the data resides on through increased awareness and responsibility among data stewards.

2020 Initiative 3: Expand the digitization of content and services in support of the 21st century teacher/learner.

Goal 3A (2020): Support the growth of distance education and online programs.

Alignment: 2020 Institutional Goal 1, (O1D)

Accomplishments:

In response to the global pandemic, CMU moved all classes fully online halfway through the spring 2020 semester and hybridized courses for the fall 2020 term. Although this was a challenging time, the effort to develop online resources, course content, and familiarity with online tools was accelerated during the pandemic. Moreover, faculty training in the use of online platforms such as D2L, Zoom, Teams, and Panopto lecture capture was expanded during this period, and the momentum gained in support of distance education and online platforms continues today. The following are examples of technologies implemented or expanded use during the pandemic and how these technologies continue to impact the growth in distance education and online programs.

The use of web conferencing platforms such as Teams and Zoom spiked during this period. Distance Education purchased a campus license for Zoom to support hybrid and online courses. Information Technology purchased additional Teams licensing which was used alongside Zoom to support virtual meetings for advising, tutoring, and faculty office hours. In addition, both products, along with the University video content management platform, Panopto, were used for recording lectures and creating course content. It is safe to say that web conferencing and lecture capture technologies became the standard for distance education at this time and are still heavily used today.

At the onset of the pandemic, classrooms were already outfitted with conference cameras and microphones for use with Panopto lecture capture. Over the summer of 2020, Information Technology retrofitted 231 smart classrooms to support wireless USB microphones with an output to the room audio system. This assisted with voice reinforcement and assisted those using web conferencing platforms for hybridized classes.

As more courses moved online or were delivered remotely, the demand for an online assessment tool increased. To meet this demand, the institution deployed Respondus Lockdown Browser and Respondus Monitor for online test proctoring. Respondus Lockdown Browser and Respondus Monitor promote academic integrity when used with other course design and assessment techniques, and these assessment tools are still available to all faculty today.

Another technology that stemmed from responding to the pandemic is virtual desktops for online computer labs. In response to moving fully online, Information Technology provided computer lab access through remote desktop using the free clientless remote desktop software Apache Guacamole. The solution sufficed during the crisis, but the product was difficult to support and did not scale well due to lab scheduling. This led to a trial of a commercial virtual desktop product by Apporto in 2022. The Apporto desktop virtualization solution improved the student experience and provided curriculum software on a persistent, virtual desktop environment from any internet-connected computer. The trial was setup for a Business Department online project management course and is still being used today.

The growth in distance education and online tools and support stemmed out of the global pandemic and the need to accommodate remote learning during this unprecedented time. However, course delivery options made available to students during this period and the advancement of mobile computing will continue to shift how students prefer to learn, although flexible course offerings have limitations that must be carefully thought through.

Goal 3B (2020): Support the adoption of digital media in lectures and course materials and provide up-to-date digital media platforms.

Alignment: 2020 Institutional Goal 1, (O1D), Goal 2 (O2E)

Accomplishments:

In addition to the adoption of the online applications and tools described under Goal 3A, to support the growth of distance education and online courses, the University migrated student files to M365, added Qualtrics for online surveys, renewed Adobe Creative Cloud and Qualtrics for online surveys, and maintained hundreds of desktop applications for academic programs.

CMU moved student accounts to Microsoft Office 365 in 2013 to provide students Office licenses and access to Microsoft online services such as email, file storage, shared workspaces, and web conferencing; however, this past fall, student home directories (F: drive) were fully migrated from on-premises storage to Microsoft OneDrive with 1TB of storage as part of the student's Microsoft account. OneDrive provides strong security features such as encryption, multifactor authentication, file versioning, and virus scanning. OneDrive also allows

individual users to share files and control access in addition to improving student online access to their documents and files in the cloud.

The number of desktop applications requested by academic departments for use in classrooms and computer labs continues to grow. This past fall, there were 277 recorded desktop applications packaged and deployed by Information Technology.

Goal 3C (2020): Provide technical training and support campus digital literacy programs.

Alignment: 2020 Institutional Goal 1, (O1D)

Accomplishments:

Perhaps the biggest gain due to the pandemic was further development of faculty skills and comfort levels with the learning management system, D2L, and supplementary learning tools that support remote learning and in-person instruction alike. 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. The training resources and support structures established during the pandemic continue to this day.

Moreover, Information Technology continuously updates the technology help desk documentation for end users and makes significant time investments to develop online resources to support digital literacy. Technology 'How To' documentation is published online for a number of help topics such as classroom AV systems, Microsoft 365 applications, and Panopto. Additionally, classroom technology and software training sessions are provided through the IT help desk on request in an effort to meet faculty where and when they need assistance.

2020 Initiative 4: Improve access to online services regardless of physical locations and time of day.

Goal 4A (2020): Increase internet bandwidth.

Alignment: 2020 Institutional Goal 1, (O1D)

Accomplishments:

CMU continues to increase its internet bandwidth subscription based on student, faculty, and staff demands for online academic resources and web-based business applications. The University doubled its internet bandwidth to 10 Gigabits per second (Gbps) in 2022 from 5 Gbps subscribed to in 2020. Over a period of 12

months, Information Technology renegotiated multiple internet service and wide area networking agreements with two providers to lower telecommunications service charges while substantially increasing the overall bandwidth serving the main and remote campuses. New internet pricing per megabit was negotiated with each internet service provider so there was only a modest budget increase. The University continues to contract for internet bandwidth from two internet service providers to ensure the availability of online services. However, the bandwidth subscribed with each provider was not balanced for better network performance in the event of a provider outage until 2022 (See Goal 2C above for more information on internet service provider failover).

CMU is also participating in the Bi-State Optical Network-West (BiSON-West) project to look at extending research fiber optic networks to Western Colorado with connectivity to the Front Range GigaPoP. Moreover, Information Technology is working with Region10 and the City of Grand Junction to support their middle mile projects to add fiber from Horizon Drive to a carrier neutral location. The University provided a letter of support for the City of Grand Junction's DOLA Carrier Neutral Colocation Project which will provide a connection from the City's carrier neutral location to the main campus. This will eventually give CMU other options for internet service and Montrose wide area network connections.

Goal 4B (2020): Expand campus wireless infrastructure and increase support for Bring Your Own Device (BYOD) and Internet of Things (IoT) trends.

Alignment: 2020 Institutional Goal 1, (O1D)

Accomplishments:

The University continues to use Aruba's ClearPass network access control software to make onboarding of BYOD devices as seamless and secure as possible for students and visitors to campus, as more and more personal wireless devices connect to the campus network each year. Last spring, over 17,000 student devices were registered on the campus network, equating to 2.48 devices per student on average (Spring 2022). Additionally, during September of 2023 alone, there were more than 1,600 self-registered visitor wireless accounts created. To accommodate this number of devices, CMU had deployed 1,141 wireless access points by fall 2023, which is only a modest increase from the 1,039 deployed in 2020 at which time the campus was considered to have blanketed Wi-Fi coverage. Most of the increase over the last three years has been due to added building square footage with capital construction of the St. Mary's Medical Education Center and Kinesiology projects.

Over the past four years, the University has been focused on upgrading its wireless infrastructure to Wi-Fi 6 (802.11ax) standard and its local area network that supports the wireless access points disbursed across all campuses (see Goal 2C for more information on the University's Network Security and Resiliency Project).

To date, Information Technology has deployed 609 Wi-Fi 6 wireless access points completing roughly half of its wireless upgrade project to improve wireless connection speeds and performance.

Another wireless initiative is improving outdoor coverage, and Information Technology has taken a more proactive approach to ensure building projects include the necessary rough-in and infrastructure to cover adjacent outdoor spaces. A prime example of this effort was the Bus Bergman Sports Complex where ten outdoor wireless access points were added to fully cover outdoor seating and common areas for athletes and spectators alike.

In addition, Information Technology finished a Wi-Fi 6 outdoor coverage plan for Montrose, Bishop and Main campuses. Designated areas on the Main and Bishop campuses where students congregate, including certain commuter parking lots, were surveyed. A plan for Montrose Campus outdoor Wi-Fi was coordinated with the City of Montrose's open community access. Areas with known good wireless coverage, implemented with recent or currently planned capital construction projects, were not included in this survey. Information Technology purchased TamoGraph wireless survey software with GPS adaptor to perform the Wi-Fi survey. The wireless survey work included a Wi-Fi heat-map coverage and proposed placement of additional outdoor wireless access points with project estimates.

Last, in conjunction with the Bishop Campus outdoor wireless survey, an interior scan was completed for Bishop Campus Building A, Building B, Archuleta Engineering Center, and Allied Health Building. This wireless survey resulted in a separate project plan and budget request being developed to add wireless access points inside Bishop Campus buildings.

Goal 4C (2020): Adopt technology solutions where mobility is the ultimate benchmark for the completeness of the solution.

Alignment: 2020 Institutional Goal 1, (O1D)

Accomplishments:

Today's traditional-aged and even most adult college students are comfortable with personal computing, internet research, and social media. In fact, most students attending college own a smartphone¹⁹ and are used to, if not coming to expect, an individual, more personal approach to collaboration and learning. Mobile computing devices, including smartphones, tablets, and laptops, are prevalent on campus today. This past Spring 2023, the average number of

¹⁹ Pew Research Center Mobile Fact Sheet April, 7, 2021. US Adults. Ages 18-29, 100% owns a cellphone, 96% smartphone (97% Vast majority of Americans now own a cellphone of some kind.) 77% Desktop or Laptop and 53% tablet US Adults

registered wireless devices per student was 2.48, and 74% of CMU students carried a laptop to campus at some point during the semester.

Moreover, faculty have anecdotally observed that most students use personal mobile computing devices in their classrooms. Over the Fall 2022 semester, the Academic Technology Advisory Council (ATAC) discussed the pros and cons of requiring students to use personal laptops for their course work following conversations on desktop virtualization and wireless printing. During these meetings, several ATAC members shared that most of their students already carry a laptop and that lab computers are broadly underutilized.

Furthermore, the University continues to adopt academic and administrative systems where mobility is expected as it digitally transforms the student experiences through increased personalization, automation, and self-service. The adoption of a mobile friendly schedule-building application to help students create and compare customized course schedule options that work with their personal and work life is just one example. In addition, the University continues to invest in wireless infrastructure to ensure student mobility (see Goal 4B). Without a doubt, ubiquitous campus wireless connectivity is central to providing students universal access to academic and administrative systems such as course materials and registration applications. However, there is still concern that some rural CMU students do not have access to affordable internet.

In 2023, CMU initiated the Student Laptop Project with one overarching goal: to create opportunities for every student to own a laptop with the performance to support the degree they are seeking. As a first step, the University created a faculty working group to better understand how students and academic programs use computer classrooms/labs and academic software to inform the Student Laptop Project. An analysis of computer classroom and lab use was performed over the Fall 2023 semester that verified the anecdotal evidence provided by ATAC members the previous fall, that most of the University computer classrooms and labs are underutilized, with 74% of these spaces classified as having medium computer use or lower.

It should also be noted that ATAC members and members of the faculty working group, as well as those who participated in working group department meetings, expressed concerns that requiring students to use a personal computer for coursework may negatively impact students or disadvantage students in certain socioeconomic groups, or that requiring part-time students to use a personal computer or requiring a student to bring a computer for an elective course may make the course prohibitively expensive. Other concerns such as program specific hardware and software requirements and the potentially negative impacts on enrollment if laptops were required were also discussed.

Work on the Student Laptop Project will continue moving forward to match University resources with student needs and expectations. It is important for the

University to provide mobile solutions to meet students where they want or need to learn, instead of enabling technology for spaces, to effectively grow the University and ensure we continue to be a value to our students and the community.

Goal 4D (2020): Explore the use of tablets as a viable desktop replacement for employees where mobility is critical to the success of their position.

Alignment: 2020 Institutional Goal 1, (O1D)

Accomplishments:

During the pandemic response of 2020, the University initiated the Faculty Laptop Program to meet requests for more mobile computing options for faculty for hybridized courses and working remote. During this time there was also a surge of tablets (e.g., iPads) to help address mobile computing needs inside and out of the classroom. Due to the volume of requests and a spike in second devices, Information Technology performed an analysis of 2-in-1 tablet computers capable of replacing the desktop and providing the mobility and features faculty were looking for in a tablet style device. The outcome of this work was a 2-in-1 tablet computer option for faculty to be phased in over six years under the PC Replacement Plan.

The Faculty Laptop Program encourages full-time faculty to opt into replacing their office desktop computer with a 2-in-1 tablet computer kit for mobility. The 2-in-1 tablet computer kit includes a docking station, full-size keyboard, mouse, and monitor. More recently, Information Technology has adopted a web-conferencing monitor with a built-in docking station to reduce the cost of the kit. The cost of the monitor with dock is considerably less than the combined cost of the separate docking station and separate conferencing monitor with webcam, although the cost to purchase the 2-in-1 tablet computer kit to replace an office setup is more than the current budgeted amount per faculty computer under the PC Replacement Plan.

Input was solicited from the Academic Technology Advisory Council at the onset of the project, and in the first year of the program, approximately 65% of the faculty opted to receive the 2-in-1 office solution over a desktop. Implementation of the Faculty Laptop Program will continue over the next few years as computers age and are due for replacement. Based on the positive response from faculty, moving forward the University should consider emphasizing the adoption of tablet computers for all faculty and re-evaluate funding and shortening the life cycle of tablet computers to four or five years. The Faculty Laptop Program model has been extended to staff positions with remote work requirements.

Goal 4E (2020): Increase the availability and performance of computer applications and systems.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

The University leverages cloud infrastructure and server virtualization technologies to provide high-availability services and applications to students, faculty, and staff with the necessary performance to support academics and administrative systems alike. The University continues to take a cloud-smart approach to selecting applications with a preference for the software as a service (SaaS) cloud delivery model. SaaS applications are delivered by the vendor as a complete solution consisting of infrastructure—computer, storage, and network resources—operating system, application, and updates with provisions for business continuity and disaster recovery. Native cloud delivered applications leverage cloud-provider capabilities for scalability, availability, and resiliency. High availability and resiliency for cloud delivered services is provided by highly redundant hardware systems and sites using clustering, load balancing workloads between redundant systems or clusters and the automatic redistribution of workloads when network or system errors or failures are detected, and automatic backup and recovery of data to alternate cloud data centers.

As of December 2023, CMU supports over 90 enterprise applications, critical to university operations, of which two-thirds currently run in the cloud. However, not all enterprise applications supported by a cloud provider are SaaS delivered; for example, the University's Banner ERP and Student Information Systems run on Ellucian's Managed Cloud (private virtual cloud) hosted environment running on Amazon Web Services (AWS). Although Banner is not SaaS delivered, the Managed Cloud environment on AWS infrastructure provides data protection safeguards including backup protocols and system performance and resiliency measures for business continuity requirements. (See Goal 1B for more information on the Ellucian Managed Cloud project.)

When it is necessary to install an application on-premises, the University leverages server virtualization technology to increase the availability of applications and services running in the University's data centers. Information Technology runs most on-premises services under VMware to reduce the potential of downtime from hardware failures and limit downtime during upgrades. The VMware server environment is comprised of physical hosts in the Main Campus primary and secondary data centers as well as server rooms at remote campuses. Server virtualization technology allows applications to share hardware resources and move hosts in the event of hardware failure. Moreover, data storage systems have hardware redundancy and data is replicated in near-real time between primary and alternate sites. Further, data backups are configured for on-premises servers, including the virtualized server environment, and a copy of data backups are stored offsite.

Depending on cloud delivered applications also makes uptime and availability of the University's network critical to operations. Over the last three years, the University has made substantial upgrades to its local and wide area networks to dramatically increase network uptime. Descriptions of network upgrades, including work completed through the State funded Network Security and Resiliency project, are described above with Goal 2C.

2020 Initiative 5: Efficiently manage university resources.

Goal 5A (2020): Increase faculty involvement in campus technology decisions.

Alignment: 2020 Institutional Goal 1, (O1D)

Accomplishments:

The Academic Technology Advisory Council (ATAC) continues to actively participate in technology decisions that impact faculty inside and out of the classroom. ATAC is comprised of representatives from each academic department, Distance Education, Library, and Information Technology. ATAC has been involved in technology decisions over the last four years ranging from the Student Laptop Project and e-Portfolios to artificial intelligence writing detection and virtual reality. The following are more descriptive examples of ATAC discussion topics that heavily influenced campus decisions over the last four years.

ATAC discusses the effectiveness of academic software platforms used campus-wide to determine if a change needs to be made prior to renewal. The University's agreement for its lecture capture and video content repository solution, Panopto, was reaching the end of its contract term in 2020. Prior to renewal, the use and functionality of the product was discussed over several meetings. Concerns brought up by ATAC members as a result of discussions with their faculty in their departments were followed up with a technical support call with Panopto which addressed ATAC and faculty member concerns, and a decision was made to renew the agreement with Panopto for three years.

CMU's Panopto agreement was reviewed again with the Academic Technology Advisory Committee in 2023. This time the discussion was not about functionality but centered on video retention and archive policies to limit price increases. Panopto notified the University that it changed its pricing model from unlimited storage to tiered storage pricing, charging significantly more for primary video storage to push institutions to use lower cost archive storage or delete unused video content altogether. During the pandemic video storage increased dramatically in order to provide alternatives for students to access recorded lectures and videos. Prior to the 2023 agreement renewal, a new Panopto video retention policy was discussed with the Academic Technology Advisor Council, and following an in-depth analysis of Panopto video usage, a retention policy of six months for primary storage was adopted, and videos with no views in six months are automatically

moved to archive storage. In addition, ATAC agreed that videos archived for two years without being viewed could be permanently deleted.

ATAC is also included in technology decisions less academic in nature, but that may have an effect on instruction or student academic progress. Over the past four years, ATAC members have been included in decisions regarding implementing multifactor authentication for M365 web email and other Office 365 applications such as OneDrive, Teams, and Outlook, and the faculty email retention policy. Following concerns expressed over the faculty six-month email retention policy, a series of discussions with Faculty Senate, Academic Affairs, other key stakeholder groups such as the Academic Technology Advisory Council, and key decision makers were held. The input from faculty was imperative in determining a reasonable default retention period and the faculty email retention policy being changed from six months to eighteen months.

Goal 5B (2020): Develop a process to prioritize technology projects to best meet the institution's strategic initiatives with available campus resources.

Alignment: 2020 Institutional Goal 3, (O3C-S2)

Accomplishments:

Information Technology continues to leverage its IT Project Scoping Document 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. 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 during the contracting process to proactively protect the University. Individual project tasks are monitored through the Information Technology work order system, Web Help Desk.

In addition, over the past two years, the Facilities Services department has developed a similar process with its Project Intake Form. Facility Services' new process is important to Information Technology as it helps align resources and determine the full scope of a building project before it begins. Many building improvement or modification projects involve technology components from structured cabling for network access to classroom changes. Likewise, most Information Technology centered projects require light construction such as rough-in, wall backing, and electrical outlets to make the project successful. The new Facilities Services process is improving communication and coordination of all aspects of building projects submitted by departments. However, more progress can be made in the areas of project coordination to ensure all aspects of the project are included in the project scope and cost before project commencement and through project execution.

Last, CMU is implementing a new operating model that in part is used to identify and stay focused on campus priorities. Information Technology is using the Entrepreneurial Operating Systems (EOS) and its protocols for leading meetings, identifying priorities, and staying on track. Information Technology directors update technology initiatives and quarterly priorities by identifying 3-year and 1-year long projects and breaking them down into 90-day projects/tasks to meet University priorities and *Forming the Future* objectives.

Goal 5C (2020): Expand technology sustainability planning inventories and practices.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

The University has a well-established, comprehensive Technology Sustainability Plan that covers all major technology systems and equipment utilized to perform its mission. It includes a collection of documents, procedures, and equipment inventories used to budget for, analyze, coordinate, and report equipment replacement initiatives. The Plan has been in place for more than fifteen years and was last updated in 2023. This work included a review of equipment lifecycles and updating the spreadsheet detailing funding by equipment category. The Technology Sustainability Plan is funded at \$1.68 million for FY2023-24, more than double from inception, and has been relatively stable for the past four years.

Current technology categories under the Technology Sustainability Plan include Servers and Data Storage; Disaster Recovery Equipment; Network Switches; Wireless Local Area Network (LAN); Wide Area Network; Instructional Technology/Classroom Audiovisual (AV); PC Replacement; Network Printers; and Converged Technology/PBX Replacement. Although the Plan has been in place for over a decade and has been relatively stable, periodic reviews of the Plan's technology asset inventories, equipment life cycles, and associated costs are actively performed with changes in technology and campus requirements.

For example, after completing the migration to Microsoft Teams for UCaaS (See Goal 6B), funding in the Converged Technology/PBX Replacement technology category will go under an extensive review to determine how much of the Technology Sustainability Plan funds for this category will need to be reallocated moving forward. Moreover, the PC Replacement portion of the Plan will be modified depending on the outcome of the Student Laptop Project and Faculty Laptop Program referenced in Goals 4C and 4D, respectively.

Goal 5D (2020): Recruit and retain well-qualified IT staff.

Alignment: 2020 Institutional Goal 1, (O1C, O1E)

Accomplishments:

The Information Technology department has been very stable and continues to build on a very talented core of individuals. Information Technology is presently comprised of 29 employees (28 FTE) with the addition of a second Systems Administrator position in 2022 to work with Microsoft Endpoint Configuration Manager, install software updates, deploy academic software, and provide tier-3 support to campus. Additionally, the Computer Support Services Manager position was promoted to Associate Director for Computer Support Services and is responsible for managing the University's desktop hardware and software purchases, academic computer labs, and computer support services.

The one work unit in Information Technology that has had any significant change has been Computer Support Services. With the retirement of the IT technician assigned to CMU Tech, the Computer Support Coordinator that oversees the day-to-day tickets of the help desk and student assistants on the Main campus moved to Bishop Campus as the Client Support Specialist to expand support for this campus. Another IT Technician was promoted to be the new IT Client Support Manager to oversee help desk services. Following these positions taking on more responsibility, the Computer Support Services work unit filled two open IT technician positions in 2023.

Moreover, after the long-time Director of Information Systems retired, an application programmer was promoted into the position following a national search. Last, Information Technology continues to promote and implement ways to effectively cross train employees in key positions to ensure the University has proper coverage for primary systems and services.

In addition to advancing IT help desk service delivery tools to reduce support time to resolve issues (see Goal 5E below), training for help desk staff continues to be a focus as foundational to delivering great end user support. This has been especially important with the staff changes in Computer Support Services over the last couple of years. Information Technology has a well-developed IT Help Desk self-training program and certification process for HP, Apple, and CompTIA A+ Certification training and eventual certification testing. The department believes that its continuous training, collaborating, staff meetings, certification training and team building have direct impact on the high quality of service we provide campus wide. These training efforts carry over to the development of our student workers. IT continues to promote and encourage a highly positive work environment for work-study students through development and implementation of a structured student training program, leading to certification as a 'Student Technician.' These initiatives support building our campus culture and position satisfaction that is important for morale as well as improving and maintaining individual skill sets.

Goal 5E (2020): Enhance IT Help Desk support services.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

Following the pandemic response, Information Technology started assessing service management applications for the Help Desk to replace the existing ticketing system in 2020-21. An objective was to provide a self-service AI tool that would also provide integrated chat services for reaching IT Help Desk staff virtually, while maintaining current functionality for asset management and Application Programming Interfaces for integrations with device registration databases. Another requirement was integrated asset management capabilities. At the time, two industry-leading vendors were evaluated with test licenses resulting in a budget request for an IT Service Management (ITSM) platform to modernize how Information Technology delivers day-to-day service to its customers.

The Information Technology Help Desk continues to invest significant amounts of time and resources in developing help documents and support platforms. End user documentation is continually updated with changes to Information Technology support options and technology purchases. In 2021-22, effort went towards developing new capabilities for the Computer Support Services portal and adding new custom support tools to assist support staff and campus computer users. Using an open-source development environment, several support tools were developed to save the Help Desk staff considerable time when assisting customers. For example, a desktop application, CMUInfo, was created and deployed university wide to help technicians and end users share key computer system information with one command, which then provided the functionality for a one step launch of a remote support session of the customer's computer. In addition, this custom support tool was modified to hook into the Help Desk KB (Knowledge Base) portal through a new API. Now when a customer runs CMUInfo, that information is submitted to the KB portal for quick retrieval and review.

Further, Information Technology upgraded its Microsoft System Center Configuration Manager installation to Microsoft Endpoint Configuration Manager (MECM) in 2021. The MECM end point management solution supports system updates and deploys desktop applications across all University locations. With the upgrade, a new imaging workflow was created to populate necessary fields automatically. This new process pulls the computer name from Web Help Desk and offers a field to enter an email address to be notified when imaging of a given computer has been completed.

The Information Technology help desk is continually working to improve first contact resolution as well as develop an overall strategy to provide our entire customer base with self-service features and more timely solutions, increasing customer satisfaction, and reducing the workload on the IT Help Desk and the IT Department. A prime example of this strategy is that following the development

of a self-service text message-based password reset process, posters were created with a QR code to direct end users to directly reset their MAVzone password through the new process. The posters were placed outside the IT Help Desk and other service offices such as IRIS to make students aware and easily redirect them to the website to resolve password related issues.

Last, the Director of Computer Support Services completed ITIL 4 (Information Technology Infrastructure Library) practices and framework training and is now ITIL certified. Learning this framework is important in identifying, planning for and implementation of a new ITSM solution. The certification is valid for 3 years, and the training will help in analysis of a new ITSM product to replace the current installation of Web Help Desk, used both for ticket tracking and asset management. The goal is to initiate the RFP process for an ITSM solution later this year.

Goal 5F (2020): Leverage cloud-based software and services where practical, economical, and provide appropriate levels of information security.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

The University continues to take a cloud-smart approach to selecting applications with a preference for the Software as a Service (SaaS) cloud delivery model. SaaS applications are delivered by the vendor as a complete solution consisting of infrastructure—computer, storage, and network resources—operating system, application, and updates with provisions for business continuity and disaster recovery. SaaS applications are developed to be mobile friendly, with more modern functionality, and release new features and updates at a faster pace than on-premises solutions.

As of December 2023, CMU supports over 90 enterprise applications, critical to university operations, of which two-thirds currently run in the cloud. This is up from 79 enterprise applications in the fall of 2020 where just under fifty percent of enterprise applications were cloud hosted. Not including infrastructure management software (e.g. wireless management software) utilized by Information Technology and Facilities Services, the percentage of enterprise applications that are cloud-based or SaaS used today for daily activities is over 80%.

The primary reason for the large increase in cloud delivered applications over the past four years is the migration of Banner ERP and Student Information System from the University's data center to Ellucian's Managed Cloud (private virtual cloud) hosted environment running on Amazon Web Services (AWS). This 'lift and shift' project moved not only ERP applications from on-premises to AWS, but all Ellucian licensed applications such as Banner Document Management, Operational Data Store, and Degree Works. However, the applications supported

by the Managed Cloud project are not SaaS delivered, although the University receives most of the same benefits of cloud infrastructure. See Goal 1B for more information on the Ellucian Managed Cloud project.

In addition, the University actively looks for feasible methods to leverage cloud services that improve access and security. Over the summer of 2023, student, faculty, and staff files (home directories) were migrated from on-premises storage to Microsoft OneDrive cloud storage. CMU's Microsoft licensing provides each user, including students, 1 TB of storage which is more than enough to cover current storage needs of individuals and provides users easy access to files from anywhere. OneDrive also provides strong security features such as encryption, multifactor authentication, file versioning, and virus scanning. OneDrive also allows individual users to share files and control access as well as sync files to a personal device to allow for off-line use of selected files.

Through a cloud-smart approach, CMU will continue to replace its legacy applications to modernize its operations for continuous delivery of new business capabilities and innovation. This goal will require long-term commitment to the University's digital transformation journey and collectively require advancements in the infrastructure and applications adopted and maintained, and network performance.

2020 Initiative 6: Advance campus technology in support of institutional initiatives and campus expansion projects.

Goal 6A (2020): Continuously enhance instructional technology standards to provide innovative teaching and learning environments.

Alignment: 2020 Institutional Goal 1, (O1D)

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 had only a modest increase in the last four years, with the addition of six technology-enhanced classrooms over this period. The University currently supports 247 classroom AV systems, up from 231 in fall of 2020. Most notable, eleven classrooms and labs were constructed with the new St. Mary's Medical Education Center that opened January of 2022. These classrooms have standard high-definition digital switching, laser projectors, and widescreen projection screens with a standard input, and source devices including wireless presentation equipment.

Further, as part of the Technology Sustainability Plan, classrooms continue to be upgraded to the latest standard. The classroom AV systems standard is continually reviewed with faculty input. As one example, it was decided to stop support for

VGA inputs this past year, the last analog input to classroom AV systems; a USB-C input was added to classroom AV systems to support newer Windows and Apple devices. Additionally, equipment supply chain issues due to COVID have complicated all efforts to install and maintain classroom technology over the last three years. For a couple of years, the core Crestron equipment for the University's classroom AV system standard took as long as twelve months to ship, making it difficult to keep classrooms operational, let alone perform any upgrades.

In addition to advancing classroom technology standards, new technology solutions were supported as the institution added academic programs. A prime example of this is the opening of the St. Mary's Medical Education Center where new applications and their associate equipment were implemented in support of the Physician Assistant program, including a virtual dissection table, a medical observation and recording solution, and virtual reality (VR) anatomy lab.

For each of these new instructional technologies, a significant amount of time was spent coordinating the onsite infrastructure, installation, and training. Each of these projects had data, audiovisual, and electrical power components to facilitate along with the program directors, faculty, design teams, general contractors, and vendors. The technology for the physical and virtual dissection rooms was expensive and new to the University. For example, operating table lights with built-in high-end cameras and large-format LED displays with special protective enclosures for corrosive environments took an enormous amount of coordination for the instruction of intricate anatomy procedure details at one operating table to be displayed to the entire class.

At the other end of the building, a new medical observation and recording solution was installed in clinical labs and exam rooms. The solution selected had to provide privacy switches to be incorporated into the building design to protect the privacy of standardized patients. Information Technology provided network and server support for the implementation of the medical observation systems along with coordinating camera and mic placements in hospital bed lab and exam room spaces, as well as helped integrate the medical capture solution with the clinical lab AV system for monitoring and playback of clinical exercises.

Information technology further supported the PA program with the adoption of VR anatomy labs with vetting, purchase, and configuration of Prospectus VR software and associated hardware. This project required significant infrastructure coordination and time to install high-end workstations with VR headsets and to test the systems overall use. Following the grand opening of the St. Mary's Medical Education Center, the PA program evaluated a second (VR) anatomy application, 3D Organon. The PA program has since shifted to 3D Organon for its VR anatomy lab work due to ease of use, costs, and features such as exam creation support.

Moving forward, Information Technology is evaluating the use of AV over IP systems to replace the more traditional digital switching and controls systems installed today.

Goal 6B (2020): Evaluate unified communication and call center solutions.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

Unified Communications is a suite of products to provide business voice calling features, video conferencing with screen/application sharing, voicemail with unified messaging, presence and instant messaging through a unified interface with business application integration for complete workspace collaboration. When delivered by a cloud provider, the platform is a Unified Communications as a Service (UCaaS) solution.

Information Technology began seriously researching the use of Microsoft's collaborative workspace and UCaaS product, MS Teams, as a possible replacement for its on-premises Private Branch Exchange (PBX) in 2019 due to its growing capabilities and the potential cost savings to the institution. Remote work became an unwanted norm during the COVID-19 pandemic, but it did make the use of softphones and web conferencing tools with online collaboration features widely accepted as the future of voice services and beyond. The University's production use of MS Teams for voice services began during the 2020 pandemic, and with Teams' add-on Phone System and Audio Conferencing licensing, it was found to be an acceptable and cost effective UCaaS solution for the University.

As of December 2023, all Main Campus faculty departments were migrated to Microsoft's UCaaS platform with MS Teams Phone utilizing the Teams desktop application with predominantly softphones has achieved a business phone solution for CMU. Combined with the completed migration of several administrative staff departments on the Main Campus, approximately 520 PBX telephones have been migrated in total to Teams Phone. Utilizing softphones through the Teams desktop application has accounted for an approximate savings of at least \$65,000 to-date in desktop telephone hardware alone. This savings doesn't include the cost efficiencies gained by not needing to augment the data network and switching of the LAN with additional hardware or capabilities to accommodate physical desk phones. Additionally, the core configuration of our Teams Phone system SaaS platform leverages our Microsoft higher-education domain pricing, direct-routing with our own call trunking, and in-house management of our DID number ranges, in concert with our on-premises session border controllers for call management, to save tens-of-thousands of dollars every year over other enterprise vendor solutions.

CMU's transition to UCaaS thus far has been a series of discovery, trial, and implementation steps to address the needs of campus to provide a reliable solution

capable of meeting the needs of each business unit as they are migrated. To reach this point, over the last three years Information Technology has tested several Teams certified desktop phones to address student worker requirements in areas such as the Recreation Center, researched and tested a session border controller with analog support to address legacy devices, and studied and contracted session initiation protocol (SIP) trunk services with enhanced-911 and redundant internet circuit to replace legacy time-division multiplexer PBX trunk lines. Key steps to finishing the move to UCaaS include final testing and acceptance of SIP trunks and porting all the campus Direct Inward Dial numbers to the SIP trunks as well as placing the SIP trunks into full production for all campus inbound and outbound call services. The University is roughly halfway to turning off its PBX. The overall anticipated savings for migrating to Teams Voice with softphones with in-house personnel is expected to reach \$250,000.

There are still hurdles to overcome before the PBX can be decommissioned. One hurdle still to be addressed is the business areas that need a contact center solution to accommodate departments with advanced call routing and tracking requirements. Part of the above savings will offset the University network equipment replacement costs that UCaaS is so reliant on and the future purchase of call center licenses.

Goal 6C (2020): Develop an Information Technology standards guide to improve communication with architects and design teams.

Alignment: 2020 Institutional Goal 3, (O3C)

Accomplishments:

CMU has maintained technology standards in support of capital construction projects and learning environments for many years, and Information Technology continually works to improve the process of how technology standards are communicated and incorporated into the work of the engineers and design teams of each project. Information Technology understands the importance of the audiovisual and low voltage systems to be included in the construction drawings and specifications. Basically, if the IT systems information is not on the drawings, then it is not coordinated in the field. Over the last four years, a process of how structured cabling system specifications are provided to project teams has been modified, with the intent to ensure that as rapid as technology and building systems change and are dependent on connectivity through the University's local area network, that each project receive project-specific sets of equipment requirements and specifications, with the request that each engineering design team leverage the information as starting points and always engineer systems based on the latest technology and equipment models. This approach was especially important with the Performing Arts project where the performing arts technology design incorporated new systems to meet this venue's requirement that

were extremely different than the audiovisual systems designed for classroom buildings.

To make this process work, at the onset of each project, Information Technology works to meet with the architect and the design team for the project. Then, Information Technology provides base information on IT requirements for building standards, audiovisual equipment standards, and structured cabling specification. The IT requirements for building projects includes starting information for topics such as classroom and group room standards with inputs; lectern drawings; digital display considerations for electronic wayfinding and announcement boards; list of standard structured cabling drop locations and common drop counts per location; outdoor plant fiber strand counts and the data center location to homerun outside cable; and requirements for wireless access point mounting details. Last, Information Technology provides a CMU Structured Cabling Specification section 271000 labeled for each capital construction project along with a PDF with sample Main Distribution Frame rack layouts and elevations with preferred patch panel spacing.

The new process has helped streamline the initial communication process to improve collaboration with architects and design teams and to avoid their use of older specifications that may not be appropriate for the current building. This problem was very common, especially on smaller projects. Information Technology will continue to hone this process to ensure CMU receives the best technology solutions on the market at the time of construction.