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# Ingredients of a High-Quality Information Systems Program in a Changing IS Landscape

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**ABSTRACT**

This paper describes James Madison University's undergraduate major in Computer Information Systems as an example of a high-quality Information Systems (IS) program and discusses our planned evolution in the context of the rapid changes of technological, business, and social factors. We have determined what we consider to be five essential ingredients of what makes JMU's program a high-quality IS major. These are: (1) building an integrated, rigorous curriculum with a strong technical foundation; (2) developing a vibrant community of faculty, students, alumni, employers, and community service organizations; (3) respecting and supporting pedagogical scholarship; (4) committing to continuous improvement and assessment; and (5) accreditation. We believe these ingredients will continue to be highly relevant as the IS discipline moves forward, but also that curriculum content will need to adjust to meet changing demand. We discuss the increasing relevance of topics such as analytics, security, and the cloud to the IS curriculum and their implications for pedagogy, accreditation, and scholarship. We hope that sharing JMU's experience, insights, and future directions will be useful to JISE's readership.

**Keywords:** IS programs, Curriculum design & development, ABET, Assessment, IS education research, Community

## 1. INTRODUCTION

What makes an Information Systems program a quality program? Prior literature has explored what makes an IS program high-quality. Some of the criteria used include rankings (DeLorenzo, Kohun, and Wood, 2006), being part of an AACSB-accredited college (Lifer, Parsons, and Miller, 2009), being ABET-accredited (MacKinnon, Elder, and Dyer, 2012, 2016), and publication of educational research (Kruck, Mathieu, and Mitri, 2013; Fornaciari et al., 2017). Ultimately, the quality decision is made by students, parents, and employers. By any of these criteria, the James Madison University (JMU) Computer Information Systems (CIS) program is a quality program. This paper is an exploration of what we think has made our program a high-quality program in the past. We explore the challenges that the program faces in a changing IS landscape.

We consider these five essential ingredients that make JMU's program a high-quality IS major. They are:

(1) An integrated, rigorous curriculum with a strong technical foundation. The major is considered one of the more difficult majors at JMU, but the students recognize that employers like the skills and knowledge that they have and pay accordingly. This ingredient is discussed in Section 2.
(2) A strong community of faculty, students, alumni, employers, and other friends. The community works together to strengthen the program and the other constituents. How and why we built the community is discussed in Section 3.
(3) Pedagogical scholarship. Faculty that invest in improving their teaching leads to improvements in the program. JMU's interest in the scholarship of teaching and learning is discussed in Section 4.
(4) A commitment to assessment with an emphasis on working together to improve student learning. In Section 5, we discuss why this has been a bedrock of our program.
(5) Accreditation. Accreditation serves as a mark of quality bestowed by an outside agency. There are costs and benefits of accreditation. The reasons for JMU pursuing ABET accreditation are presented in Section 6.

We believe these ingredients will continue to be highly relevant as the IS discipline moves forward, but also that curriculum content will need to adjust to meet changing demand. In this article, we discuss JMU's approach with respect to these five ingredients.

In subsequent sections, we review the JMU curriculum and the characteristics of top-ranked, undergraduate IS programs based on U.S. News & World Report and College Factual rankings. We describe JMU's approach to community building among all constituents. We delve into the advantages of the teacher-scholar model with respect to research and its relationship to JISE's mission. We discuss both ABET and AACSB accreditation standards, and we relate these to best assessment practices. We discuss the increasing relevance of topics such as analytics and security to the IS curriculum and their implications for pedagogy, accreditation, and scholarship. We hope that sharing JMU's experience, insights, and future directions will be useful to JISE's readership.

## 2. INGREDIENT: CURRICULUM

At JMU, we believe that a high-quality IS curriculum includes some key characteristics. It requires a **strong technical foundation**. This means it is more than a management major with some IT content. Students should be able to "walk the walk" in addition to "talking the talk." Corollary to this is the requirement that the program is **rigorous**. Naturally, part of this rigor involves technical proficiency. But rigor also applies to non-technical aspects, including conceptual modeling, requirements elicitation, and both written and oral communication. A high-quality curriculum should also be **integrated**. This means that it does not consist of disparate and unconnected courses, but rather that the courses interrelate so that their topics can be found in and referred to multiple times throughout the student's academic career. This integration requires a community of faculty working together, an ingredient which is covered in depth in Section 3 of this article. A quality curriculum should include a reasonable degree of **breadth and depth**. This requires significant credit hours and course load. A quality IS curriculum should be **domain-related**. Information systems is not simply a technical discipline; rather, it involves the application of technology to a broader purpose. This may be, and often is, business but could also involve other domains. Finally, in the context of a rapidly changing technological climate, a quality curriculum must be **adaptive** while still maintaining a coherent theme. This section discusses JMU's approach to achieving these goals.

To provide a broader context, we discuss these characteristics in relation to the IS2010 model curriculum, ABET's IS accreditation requirements, and the highest-ranking programs from College Factual and from U.S. News & World Report.

### 2.1 IS2010 Model Curriculum and ABET Information Systems Accreditation Standards

The IS2010 model curriculum (Topi et al., 2010) has been very influential for many schools in helping to craft and revise their information systems programs. This was a revision of IS2002 (Gorgone et al., 2002) which in turn was a minor update to IS'97 (Davis et al., 1997). Efforts are underway to create an IS2020 model curriculum (Salmela, 2019). This continuing evolution illustrates the adaptive necessities of IS education. The main organizations involved in sponsoring the IS2010 model curriculum are the Association for Computing Machinery (ACM) and the Association for Information Systems (AIS).

The Accrediting Board for Engineering and Technology (ABET) began accrediting information systems programs in 2001, and there are currently 40 ABET-accredited undergraduate IS programs (ABET-Accredited Programs, 2019). ABET accreditation is further discussed in Section 6 of this article.

In terms of curriculum, there is some overlap but also significant disparity between IS2010 and ABET (Saulnier and White, 2011). Table 1 shows a side-by-side comparison of these standards. IS2010 lists specific course requirements. ABET does not list courses but specifies the required content. Both IS2010 and ABET stress the importance of applying technology to a particular domain. IS2010 has two major changes from IS2002. First, there is no programming requirement, which puts it at odds with ABET. Second, there is no longer the assumption that the domain of application is business.

At JMU we have made much use of both IS2010 and ABET recommendations, while at the same time trying to remain true to our own IS education philosophy. JMU has been ABET-accredited since 2003. More on our ABET accreditation, including costs and benefits, are described in Section 6.

| **IS2010 Model Curriculum Required Courses**<br>(Topi et al., 2010) | **ABET IS Accreditation Curriculum Requirements**<br>ABET (2017) |
|---|---|
| IS 2010.1 Foundations of Information Systems<br>IS 2010.2 Data and Information Management<br>IS 2010.3 Enterprise Architecture<br>IS 2010.4 IS Project Management<br>IS 2010.5 IT Infrastructure<br>IS 2010.6 Systems Analysis & Design<br>IS 2010.7 IS Strategy, Mgt, and Acquisition | 1. Coverage of the fundamentals of application development, data management, networking and data communications, security of information systems, systems analysis and design, and the role of Information Systems in organizations<br><br>2. Advanced course work that builds on the fundamental course work to provide depth<br><br>Total 30 credits (one full year) including an introduction to IS |
| **IS2010 Domain Requirements** | **ABET Domain Requirements** |
| The model curriculum is not restricted to a specific domain; all Information Systems programs are, however, linked to some domain.<br>IS professionals exist in a broad variety of domains, including, for example, business, healthcare, government, and nonprofit organizations. | Information Systems Environment: One-half year (15 credits) of course work that must include a cohesive set of topics that provide an understanding of an environment in which the information systems will be applied professionally |

**Table 1. Comparing IS2010 to ABET in terms of IS Curriculum Requirements**

### 2.2 High Ranked U.S. Information Systems Programs

In an effort to identify characteristics of high-quality undergraduate IS curricula, we analyzed websites of the top 10 programs from (a) College Factual Computer Information Systems rankings, (b) College Factual Management Information Systems rankings, and (c) U.S. News & World Report Undergraduate Management Information Systems rankings. Appendix A shows the universities in these top rankings (Table A.1) and summarizes the curricula of these programs (Table A.2). Appendix A also presents several caveats about these rankings, including uncertainty about the specific programs being ranked, definitional questions about program names, and differences in ranking methodology.

JMU is currently ranked 5th among CIS programs in College Factual and is one of the few non-R1 schools to be among top-10 programs.

Most of the highly ranked programs, especially those in public universities like JMU, follow a "traditional" theme and are housed in a business school. Others are more eclectic, especially those housed in non-business colleges and/or from private institutions. The median number of required courses (beyond the introductory IS course typically required for all business majors) in these top-ranked IS programs is five, with a median of two additional major electives. This speaks to the importance of depth and breadth; most of the highly ranked programs have a minimum of 21 credits outside the domain (e.g., business) core. The 21-credit major is nearly consistent with IS2010 prescriptions. But it falls significantly short of ABET accreditation requirements. Among the listed programs, only New Jersey Institute of Technology and JMU have ABET accreditation. ABET requires only a half-year in the "information systems environment" (domain). It is harder for a business program to get ABET accreditation than a non-business program for the obvious reason that the business core is generally so large.

Consider some outliers. NJIT and New York University have curricula of 14 and 15 classes respectively. These are housed in non-business colleges, resulting in smaller domain cores. At the other extreme is the University of Pennsylvania and Northeastern University whose IS programs are tracks or concentrations of a business major instead of full-fledged majors. The tracks require only 3-4 courses total.

The most universally required courses among the top-ranked programs are database, programming, and systems analysis & design (SAD). The prevalence of database and SAD should not be surprising given that these are central to what most people think of as key skills for IS professionals. These topics are deemed vital in both the IS2010 model curriculum and ABET accreditation.

Perhaps more surprising is the ubiquity of computer programming, especially considering that IS2010 removed application development from the required courses in its model curriculum. Two-thirds of the highly ranked IS programs include at least one required programming course, and several require two. In fact, programming is far more pervasive as a requirement than networking or infrastructure. Less than half of the top-ranked programs have requirements for data communication or IT infrastructure. This is in contrast to both ABET and IS2010 requirements.

Also contrary to IS2010 prescriptions is the relative absence of project management and strategy in required coursework. There are more required business intelligence (BI) or analytics courses among the top-ranked schools than either project management or strategy. Note that analytics/BI is not found in either IS2010 or ABET curriculum requirements.

Surprisingly, most programs do not include a required security class, which may conflict with current ABET prescriptions, although security topics are probably embedded in other coursework.

Nine of the schools, including JMU, have an explicit capstone course, designed to put all the previous coursework together and thereby provide an integrative experience for students.

### 2.3 JMU's Curriculum

JMU consistently ranks fifth or sixth in the College Factual CIS rankings. When Bloomberg Business Week ranked IS programs in 2012 and 2013, JMU was ranked 9$^{th}$ and 10$^{th}$, respectively. JMU is relatively unique among top-ranked IS programs. JMU is classified as a regional, comprehensive school, and we serve mostly an undergraduate student body, whereas most others are R1 institutions with extensive graduate and Ph.D. programs.

At JMU, the CIS major includes 28 credit hours (10 courses) beyond the business core for all BBA students. These 28 credits, added to the BBA introduction to IS course, makes a total of 31, which meets the ABET curricular requirement.

Some courses in the CIS major are more technical and hands-on, whereas others are more business-oriented, managerial, and conceptual. The curriculum can be thought of in terms of three major themes, as shown in Figure 1. These are Application Development, Architecture/Networking/Security, and Business Intelligence. The themes of the program help to frame it and provide context for integration.

**2.3.1 Strong technical foundation.** Our CIS major includes two required 3-credit programming courses, an introduction with Python and an intermediate course with Java. Within the Python course, students learn programming fundamentals; then they dive into details of object orientation, database connectivity, and GUI with the Java course. We believe that a strong technical foundation is important for success in IS-related careers. This was also a clear message from the CIS advisory board (discussed in Section 3). The emphasis on programming skills in our curriculum is consistent with the other top-10 ranked College Factual and U.S. News programs and with ABET accreditation standards, but differs from IS2010. Our curriculum includes five of the seven IS2010 required courses. But, instead of requiring project management and strategy, we instead require two programming courses. Both Saulnier and White (2011) and Bell, Mills, and Fadel (2013) found that many other IS programs also decided to keep application development requirements in their curricula despite IS2010's recommendations. It will be interesting to see how IS2020 addresses the notion of coding as an important IS skill.

**2.3.2 Adaptiveness.** Like most (but not all) other top-10 ranked programs, JMU's CIS curriculum includes required courses in database and systems analysis. We also include a required enterprise architecture class, a required networking and

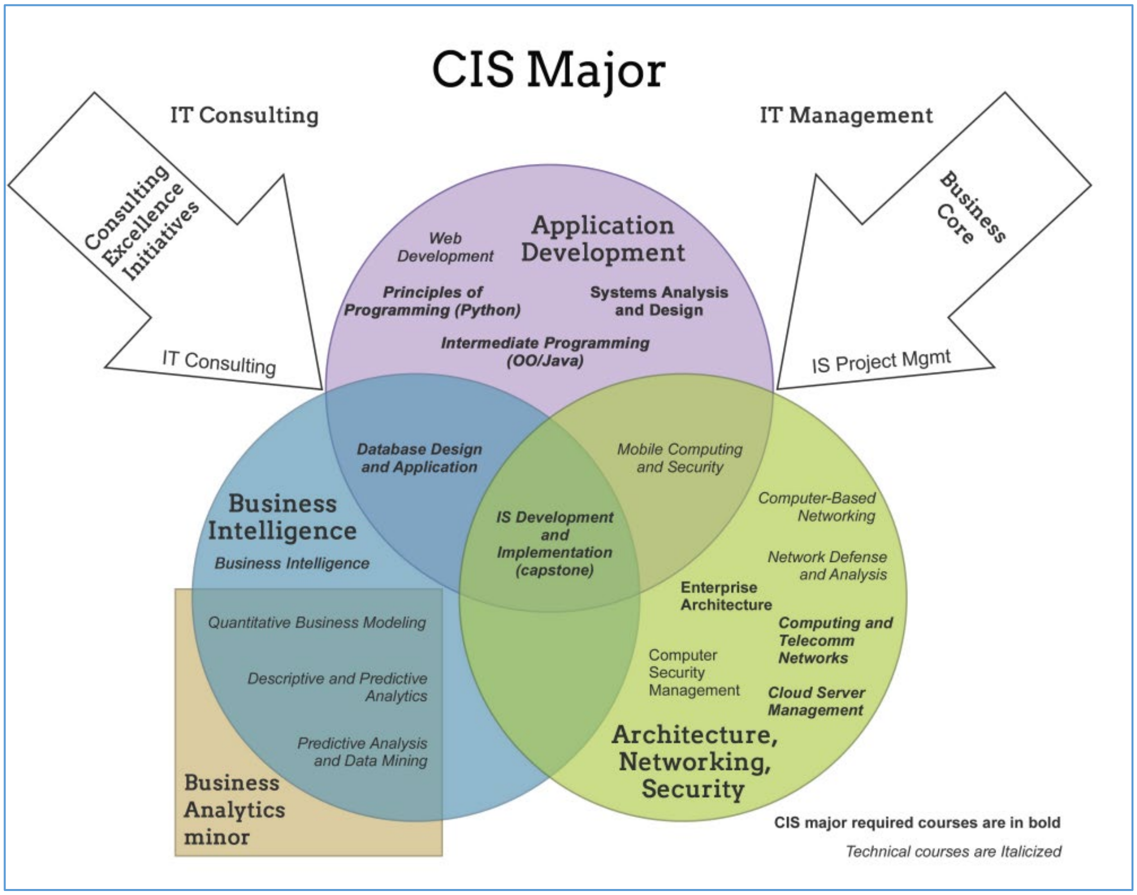


**Figure 1. Graphical Representation of JMU's CIS Major (Includes Business Analytics Minor)**

telecommunications class, and a required one-credit cloud server management lab. These requirements are much less common among programs in the top-10 lists.

The enterprise architecture class is an example of adaptiveness in our curriculum development. It was introduced in 2010 under the name "Information Technology Enterprise Integration" and changed to "Enterprise Architecture" in 2012 to be consistent with the IS2010 nomenclature. It replaced a course called "Information Technology" which was essentially a hardware course. Whereas the previous course was focused on PC hardware and operating systems, the newer course emphasized the enterprise and the integration of technology to a broader and more global environment. This is consistent with changes from IS'97 and IS2002 to IS2010 model curricula. It is also consistent with changes in ABET accreditation standards over the years. This adaptiveness as applied to enterprise architecture is described in Topi et al (2010, p. 385):

> The IS2002 model curriculum includes both an IT Hardware and System Software course (IS 2002.4) and a Network and Telecommunication course (IS 2002.6) to edify the concepts and practices related to IT infrastructure. The IS 2010 model curriculum proposes a different approach, which integrates the material included in IS 2002 into IS 2010.5 IT Infrastructure course and introduces a new IS 2010.3 Enterprise Architecture course that focuses on concepts at a "higher level of abstraction.

Our Cloud Server Management course is an example of adaptively adjusting to changing technologies. This is a one-credit lab course that began many years ago to give students experience with either personal productivity software or Perl programming, depending on the interests of the instructor. Over time, and as the previous hardware course was switching to an enterprise architecture direction, we decided to orient this lab course to focus on server administration and operating systems. Although few of our students will turn out to be system administrators, we thought it was important for them to get a taste of it. Originally, it was done with local IP addresses, but the costs of doing this and the opportunities of free cloud-based services, such as AWS, encouraged us to change it accordingly into a cloud server management lab. Our major employers (see Section 3) appreciate the AWS experience that their JMU recruits bring to the job.

Other adaptations in recent years include integrating SCRUM into our systems analysis course, changing the introductory programming language from Visual Basic to

Python, and using AWS cloud services for teaching machine learning and NoSQL databases in the BI class. An adaptive curriculum is one that constantly evolves.

**2.3.3 Breadth and depth.** In general, the 28 credits (10 classes) of our major is heavier than the norm among other top-10 programs of College Factual and U.S. News, which require around 21 credits (7 classes), on average. So, in addition to a strong technical foundation, we offer a broad spectrum of IS content and practice. This points to JMU's philosophy of the importance of breadth and depth. Programs that only require a few courses don't provide enough breadth and depth in the major.

**2.3.4 Rigor.** In addition to the strong technical foundation, our curriculum places a heavy emphasis on building skills in conceptual modeling. Diagramming is a key component in our enterprise architecture class, our database class, and our systems analysis class. Students become fluent in activity (process), network, entity relationship, class, sequence, and use case modeling in these three classes, and they put these into practice in the capstone class. Diagramming is one form of communication; others include written and oral. Throughout their major coursework, they are required to write documents, communicate in meeting environments for requirements elicitation, and present in front of audiences. This, in addition to the strong technical requirements, attests to the rigor of JMU's program.

**2.3.5 Integration.** JMU's IS development and implementation course is our capstone and puts into practice the skills learned in previous programming, database, and systems analysis courses. This is one example of the integrated nature of our curriculum. We believe a capstone experience is a key ingredient if students are going to be able to put all their skills together into a cohesive whole. We also think it is important for the capstone to involve a community experience, so the capstone project involves building a real system from scratch for a business or non-profit organization.

Another expression of the integrated nature of our curriculum is our approach to requirements elicitation, the IS task of communicating with clients in order to ascertain their needs. In 2014, our assessment results (Section 5) indicated that we had a weakness in this area. This led to a team-based initiative among our community of faculty (Section 3) to infuse requirements elicitation practice into several courses of the major. This threading of a common topic and skill at various points throughout the students learning environment is an example of integration. The responsiveness to assessment findings also illustrates the importance of adaptiveness when building and improving a quality program. Assessment only works if it leads to "closing the loop."

In addition to 22 credits of CIS required core courses, students must take two 3-credit CIS electives to complete the major. Through these electives, students can specialize in areas most relevant to their interests. Like the core curriculum, the electives include both technical and managerial courses. The electives relate to security, analytics, application development, consulting, and strategy.

**2.3.6 Domain-Related.** Housed in the college of business, JMU's CIS program focuses on the business domain. Students' domain knowledge includes the typical coursework for a business degree, much like many other IS majors. JMU's business college emphasizes teamwork, and it places significant quantitative demand into the business core (calculus, statistics, quantitative methods, and operations management).

Geography often influences the domain focus of an IS curriculum because of the needs of employers in the school's surrounding areas. Most JMU students come from the northern Virginia area, and our most ubiquitous recruiters are consulting firms in the IT space, often with government clients. So, many of our students begin careers in consulting. Therefore, consulting has an important place in our curriculum. One of the senior-level electives is IT consulting, which is coordinated by a faculty member but largely taught and mentored by industry partners, often alumni from our major employers. Again, the community ingredient is key to the success of our program. Regardless of the industry focus of a school's geography, maintaining and nurturing links to employers and alumni is an important piece of an IS curriculum. We discuss this community aspect in Section 3.

### 2.4 Responding to the Changing Landscape

The theme of this special issue of JISE is "The Changing Landscape of IS Education." Here we describe one of the things on which JMU is working as we to prepare our curriculum for this changing landscape.

It is obvious that data science and artificial intelligence (AI) are a huge part of the changing IS landscape. We are trying to be adaptive to this demand. A major thrust in JMU's curriculum development plans involves greater integration of IS with analytics and AI. Our department includes faculty from both information systems and business analytics (quantitative methods) disciplines.

JMU's Business Analytics (BSAN) minor serves students from a variety of majors within the business college and across campus, including CIS majors. The BSAN minor requires prerequisite coursework in calculus, statistics, and quantitative methods (management science). These courses are among the business core requirements for all college of business students. Once admitted as a BSAN minor, students take three quantitatively-oriented courses. One is a descriptive and predictive analytics course that gives students more advanced statistical skills. The second is a quantitative modeling course focusing on prescriptive analytics. And the third is a data mining course focusing on predictive analytics. All three courses are taught in a lab environment.

One of the senior-level CIS electives is business intelligence. This lab-oriented course requires database as a prerequisite. Students get experience and practice with advanced database querying, data integration, data visualization, data mining, online analytical processing (OLAP), artificial intelligence, and a taste of natural language processing (NLP).

Currently, faculty are grappling with the question: given the increased importance of analytics-related skills in the IS marketplace, how can we best integrate BSAN and CIS? One obvious choice is to encourage CIS majors to add the BSAN minor. This requires that students take two additional, challenging courses to complete the minor and increase their total credit hours needed for graduation from 120 to 126, and many students don't find this to be a cost-effective option.

Another approach is to create a track within the major (a specialized major) and replace some courses of the traditional major with analytics courses. This can easily be done with existing course work. But this strategy may conflict with ABET accreditation requirements and IS2010. Figure 1 shows the main areas in the CIS major and the specific required and elective courses. If, for example, we decide to replace the enterprise architecture and telecommunications courses (both plausible given the relatively low percentages of these in the highly-ranked programs discussed above and shown in Appendix A), this could affect ABET accreditation (Section 6). It also removes two courses that are in the IS2010 requirements.

A third approach is to create a separate, new analytics-oriented major by mixing selected CIS courses with BSAN courses (Mitri and Palocsay, 2015). For public universities in Virginia, creating a new major is a lengthy bureaucratic process with the State Council of Higher Education for Virginia (SCHEV), and it can take up to three years to get state approval. We would like to make our offerings to students earlier than that.

Whichever route we take, there is no question that this will be a work in progress. Obviously, a robust analytics-focused IS program will need additional new skills. Big data, NoSQL, NLP, agent-based reasoning, ontologies, deep learning – all of these are emerging technologies that will bring intelligence into information systems. IS practitioners are going to need to understand how to work with these new tools and techniques and apply them to complex real-world problems. They will also need to be cognizant of the social impacts of such powerful technologies and learn how to apply them in a wise and ethical manner. As JMU's CIS program navigates through the changing landscape, we as educators are responsible for finding ways to address these needs.

## 3. INGREDIENT: DEVELOPING A COMMUNITY

The second ingredient for a successful CIS program is to create and maintain a positive community for the students, faculty, and broader external constituents of the program. These broader constituents may include alumni, employers, and recruiters of the program, and also the constituents that feed into the program, such as middle and high schools, community colleges, and non-profit organizations. We believe that building a strong community strengthens the CIS program.

Our consulting class is a perfect example of why and how JMU builds community (Dillon and Lending, 2014). In our information technology consulting elective class, consulting firms are paired with student teams. The firms mentor the students for an eight-week consulting project. A graduate from 2004 that participated in our consulting class as a student, realized in 2012 that he was now in a role with his small firm where he could give back by serving as a mentor to a student team. He contacted his now retired professor, who forwarded his "request to serve" to the current consulting class professor, who quickly placed him into the consulting class as a guest speaker. The following year, our graduate and his firm became a mentoring firm for a student team. In 2018, the first year his firm hired new hires straight out of college, his firm extended job offers to six CIS majors, with four accepting. Five of the six offers were extended to students enrolled in the consulting class. The class has been offered for 20 years with over 580 students mentored by a consulting firm. These firms are filled with devoted alumni that visit our campus regularly, building relationships with current students and maintaining relationships with our faculty.

We divide community into three dimensions: students, faculty, and the broader community, but you will see that the activities that build community are overlapping and self-perpetuating.

### 3.1 Community Building for CIS Students

There are many activities used to build a community for students. Some are intended to prepare, others are calculated to challenge, and still others are designed to allow students to rise into leadership and service. Each of the activities presented improves engagement and participation, allowing students to apply skills learned in or out of class. We begin with embedded activities and follow with those outside the classroom.

**3.1.1 Embedded – First and second year.** Embedding activities into the CIS curriculum that allow a typical CIS major to scaffold into the greater CIS community can begin with a simple visit by young alumni or corporate recruiters as classroom guest speakers. First- and second-year students enrolled in an introductory CIS class often report that a classroom visit by an alumnus that presented on "A Day in the Life of a First-Year IT Consultant" is the catalyst for a major change or selection. We have learned that the CIS major is often hard to describe to the inexperienced. But after a classroom discussion on information systems careers, first- and second-year students grasp the possible roles they may play upon graduation with the CIS major.

**3.1.2 Embedded – Third and fourth year.** In the third year, embedded activities become more engaging and more purposeful toward career outcomes. We apply a join-the-community focus, preparing for an internship search and developing a resume. A course unit on careers is required for all third-year students. They are instructed on how to prepare a resume for a CIS internship search and required to create an acceptable resume for a submitted grade. Students are provided guidance on creating a mandatory CIS focused LinkedIn website and are required to attend two on-campus or off-campus professional meetings (Akbulut-Bailey, 2012). We encourage those meetings to be CIS-focused, such as the student chapter of the Association for Information Systems (AIS), but other organizations are acceptable.

The join-the-community focus emphasizes using the campus resources available. The job-search website, currently Handshake provided by the Career Office, is discussed in class, and students are encouraged to learn to use the tool advantageously. The campus career center is invited to offer resume workshops and interview preparation seminars and to collaborate closely with the CIS program on shared goals.

Third- and fourth-year students are encouraged to prepare to join the greater CIS community in their major classes in more content-specific ways. Faculty are encouraged to identify creative ways to challenge their students with embedded activities (Granger et al., 2007). For example, student teams may research a topic, present the topic to the class, and then create poster presentations with supporting documentation. The poster presentations are given publicly where the quality is judged by faculty or alumni. The winning team is awarded a prize and interviewed for a college website posting.

For a second example, student teams from multiple sections of a telecommunications class are provided the preliminary materials for the Information and Telecommunications Education and Research Association's (ITERA) case study competition. The student teams engage in a semester-long effort to solve the real-world telecommunications problem proposed by the ITERA judges. At the end of the semester, a team of alumni judges select the best case-study solution, and that solution is then submitted to ITERA. The students' community is expanded beyond the classroom to the international telecommunications community.

**3.1.3 Embedded – Fourth-Year capstone course.** An embedded competition that builds community surrounds the capstone course in the CIS curriculum. An outside customer or client (nonprofit organization, government agency, or small business) is located by the course instructor. CIS major project teams are assigned an eight-week engagement where student teams plan the project, gather the requirements (Akbulut-Bailey, 2012; Cole et al., 2018), design the database, code the application, and implement the solution. A large consulting firm provides mentors that provide guidance on meeting with clients, managing the project, and preparing for the final presentation.

**3.1.4 Embedded – Gathering for the capstone course.** The CIS major is quite large and can have up to 20 student teams. With two weeks left in the semester, a faculty panel reduces the student teams to two finalists. The finalist teams each give a solution presentation to a panel of judges that includes a senior partner from a mentoring firm, faculty, and the client. To build community, the solution presentation is considered a CIS-major event and is attended by CIS students enrolled in second- and third-year computer programming courses. The attendance for this event reaches up to 300 students, 10 faculty, mentors from the participating firm, client representatives, and visiting alumni. Requiring second- and third-year students to attend the capstone event allows them to see the skills and talents they will learn, admire the accomplishments of their peers, and encourage membership in the greater CIS community.

**3.1.5 Competitive events with external sponsors.** A positive method to build community for CIS majors is to provide opportunities to compete while also interacting with alumni or future employers or recruiters (Koch and Kayworth, 2010). Competitive events with outside sponsorship allow students to shine in an academic pursuit. Sponsored academic competitions on our campus have included an analytics challenge, an innovation challenge, an incubator challenge, and a hackathon, among others. Students engage with alumni, employers, and the greater community. No matter if they win or lose, students have a winning line for their resume and a great point of discussion for a job interview. A few even win the opportunity to intern.

**3.1.6 Developing community through student organizations.** There are national organizations that support student chapters. The Association for Information Systems (AIS), Association for Information Technology Professionals (CompTia AITP), Association for Computing Machinery (ACM), Women in Technology (WIT), and Women in Computing (WIC) appear to be the most popular. All allow students the opportunity to lead, connect, and organize people and events (Koch and Kayworth, 2010). Successful student organizations are best when they are student-run, electing their own officers, holding regular meetings, and achieving student leadership-set goals (Akbulut-Bailey, 2012). Student organizations allow students to build their own community and to play a role in its development. Student organizations host guest speakers, recruiters, or advisory board members. On occasion, student-directed organizations fail when the leadership is not motivated or capable. But overall, student-led organizations are a great community builder. We share our goal of building community with the student leaders. The student leadership recognizes the importance of our shared goal, which enhances community building.

**3.1.7 Community through representing the CIS program.** Student leaders are encouraged to represent the program that they have chosen as a major. The greater university community provides opportunities for CIS majors to present and speak before small and large audiences, including events for high school students (Koch and Kayworth, 2010). The student speakers representing our program are engaging and fill a vital information-sharing role. We have even found that CIS majors play a role in assisting first-year students in making academic decisions.

**3.1.8 Community through mentoring/tutoring service.** CIS majors have knowledge to share. Not only their technical skills, but also their knowledge of teamwork, task completion, and choice of career path. Our CIS program sponsors one-day field trips for middle and high school students (Dillon, Thomas, and Reif, 2016) to encourage them to consider technology careers (Brookshire, et al., 2008). CIS students assist with these programs and serve as leaders, teachers, tutors, and mentors. These programs are particularly successful when directed to underserved and underrepresented populations (Granger et al., 2007). They also allow us to expand our community to the middle and high schools that we serve. The teachers, counselors, and principals of these schools join our community as well (Akbulut-Bailey, 2012).

### 3.2 Community Building for CIS Faculty

Every organization wants employees committed to success and employees that perform at their best (Tan and Lim 2009), which are both achieved by generating trust in coworkers and the workplace. Building community in the workplace centers on three key issues (Mitzberg, 2009): the work we do, the colleagues that share in our community, and the focus or mission of our work. To build community we identify our place in the world. As individuals, we define how our personal mission fits the mission of the department, the college, and the university. As colleagues, we build trust, understand our shared mission, and work together on activities that have meaning to the community (Amabile and Kramer, 2011).

**3.2.1 Building community from the middle.** We chose to build community from the middle by using faculty leaders, not just an administrative department chair or head (Amabile and Kramer, 2011). The faculty leaders are mid-career, tenured faculty. The faculty leaders build trust with junior faculty by sharing failures and successes and knowing and discussing the shared mission. They build trust by leading in the work that has meaning to the community. These faculty leaders act as both catalysts and nurturers. They advise the department head and are catalysts for change, but are also nurturers that provide open dialog, guide junior faculty, and provide unofficial mentorship into the mission, work, and community.

**3.2.2 Curriculum, community, and assessment.** Our mid-career, tenured faculty chose three leadership community themes that focus on our work and mission: curriculum, community, and assessment. Each of these themes stands by itself, but to be a successful program these themes must weave together. **Curriculum** is the content that is scaffolded from lower-level foundation classes through the upper-level content that then peaks in a capstone course. **Community** maintains a focus on the students we teach, the graduates and alumni we prepared, the recruiters and industry we serve, and the broader constituency that feeds the program. **Assessment** is the process that determines that true learning is taking place at all levels of the curriculum, and that discussions are always present for continuous improvement. A successful assessment process leads to successful accreditation.

**3.2.3 Course coordinators.** JMU uses course coordinators for each required course that we teach in the curriculum. This service role organizes textbooks and encourages the sharing of teaching materials, but also assists with assessment and accreditation activities. Course coordinators are first to notice the need for change in learning objectives and course descriptions. Course coordination is a role that places a faculty member into the community and provides an opportunity to engage in the shared mission of the program.

**3.2.4 Mentoring.** Building community for CIS faculty means providing mentorship for junior faculty. There does not have to be a formalized faculty mentorship program, but it is important to establish a practice for goal setting with a process loop. A process loop allows for self-reinforcing benefits for both the individual and the CIS program. This process loop may be done with regular, formalized faculty evaluations or less formal reviews of teaching, research, and service. We encourage intrapreneurship in our new faculty, especially when there is synergy with teaching, research, and/or service. A recent example is creating and advising a Sports Analytics Club. The topic is of interest to many students, current faculty publish in the domain, the department has an academic minor in Business Analytics, and business analytics topics are offered as electives in the CIS major. Starting a student club is a first great step in enhancing community.

**3.2.5 Senior faculty as teaching resources.** We share teaching resources with new faculty to build a stronger community and a team environment. When a new faculty member joins the program, senior and experienced faculty provide all material previously created for the courses that the new hire will teach. We place an emphasis on teaching success and provide guidance on curriculum and classroom activities that enhance student engagement and student learning. A shared teaching focus enhances our mission and places attention on the work we do. The newly hired may or may not use the provided materials, but if they do, they are encouraged to improve, enhance, and re-share successes and failures with the team.

**3.2.6 Outside specialists as teaching resources.** Occasionally, new topics or content must be added to the CIS curriculum that no faculty member has the expertise to teach. We form partnerships with alumni or advisory board members to meet this need. For example, during an advisory board meeting, we shared our then lack of depth and knowledge on recent cybersecurity issues. A member of our advisory board volunteered to team-teach the cybersecurity class. He met with the course instructor, planned the course content, provided resources, and visited the class once a week to present and share. The instructor and the expert created the class together. The instructor designed learning activities, teaching materials, and evaluation methods while learning and enhancing knowledge of curriculum content.

**3.2.7 Mentoring for research and service.** Successful mentoring focuses on research and service. Building a faculty community means providing co-authoring opportunities for colleagues and helping those colleagues build research networks with like-minded researchers. Encouraging new faculty to engage in new faculty consortiums and to join professional organizations permits them to build networks. Just like student organizations build community, so do faculty professional organizations. Membership in an organization provides opportunities for faculty to lead, organize, and serve. These are transferable skills that enhance the community of our team. We recommend that all faculty participate early in service activities. As faculty grow into the community, they move into leadership roles that fit their personal desires and the organization's needs. Everyone is encouraged to balance commitments between departmental, college/university, and community service. The CIS program exists in a larger community, and the successes of a CIS program has some dependence on the larger communities that surround it. Programs should seek out opportunities provided locally.

### 3.3 Community Building with Broader External Constituents

The broader constituents of our CIS program incorporate our campus, alumni, local community, and region. We have found that a key to community building is to provide external constituents with meaningful roles and then allow them to expand the quantity and quality of their contribution. They sponsor external events and competitions; serve as course-embedded presenters, mentors and judges; support student organizations; and serve as teaching resources. It may take years to craft an effective external community but we recommend some options to build the community.

**3.3.1 The advisory board.** The CIS program is heavily invested in an advisory board composed of alumni and representatives of the firms that hire our students. Our advisory board has about 25 members, meets twice a year, and is a primary community-building tool. Members from the board provide feedback on curriculum, hiring processes, and strategic direction. They also serve as outside representatives for accreditation. Advisory board members serve as class embedded guest speakers, judges, and mentors. They recommend other alumni or friends to serve in further volunteer roles. They are the connecting link for community-building.

**3.3.2 Using the career office and university employer relations.** Most colleges and universities have a career office that provides services in resume and cover letter writing, career decision making, job interview preparation skills, recruiting services, networking events, and assistance with obtaining internships (McKay, 2018). The career office will also subscribe to or maintain a job and internship search website or social platform, such as Handshake. Handshake filters allow students to search for full-time employment, internships, and externships (Lunden, 2018), both in and outside of the geographic region.

**3.3.3 Community building with a free lunch.** Just having career services is not enough if your CIS program desires to create community with the alumni and employers that recruit from your program. We recommend that faculty lunch with visiting recruiters when they are on campus and discuss highlights from your CIS program and issues of interested to the recruiter.

**3.3.4 Community building with social media.** CIS majors are required to connect to faculty in the CIS program with LinkedIn. This is a course-embedded, community-building activity that has built a large, connected community. Our college of business pays for LinkedIn membership for the faculty member that leads community building. It is viewed as a good investment by the department and the college. Embedding a LinkedIn webpage assignment provides recruiters with easier access to qualified students for internships and employment. Students regularly report that recruiters and alumni reach out on LinkedIn for potential hires (Heathfield, 2013). Universities now purchase contact information from LinkedIn and report that alumni are more likely to update a LinkedIn webpage than update the alumni office directly. Embedding the creation of a LinkedIn webpage into a CIS class in the junior year provides a beginning step for a life of staying in contact with an alma mater while also meeting the goal of joining the greater CIS community.

### 3.4 Responding to the Changing Landscape for Community Building

Community building takes time, often years. When considering organizational community building we need to contemplate the transformation that is going to happen. Faculty are hired, rise into senior roles, and then retire. With this cycle, the level of commitment to community building does not remain the same. But steps can be initiated to respond to the changing landscape. We recommend including community building in the evaluation process, program-centered social media, and succession planning.

Begin by rewarding community engagement within the organization and documentation. On yearly performance evaluations, include a count of the number of guest speakers that present in classes. Identify community engagement activities in tenure and promotion documents under contributions of teaching, research, and service where appropriate. Encourage CIS faculty to pursue qualitative research (Myers, 1997; Myers and Avison, 2002), such as interviews and case studies. This allows faculty to engage with alumni and employers, and it allows these alumni and employers to engage back with faculty.

Encourage the use of professional social media by students, alumni, faculty, and the greater community. LinkedIn greatly enhanced our community building along with the community building for the university. But social media changes, so maintaining community will mean keeping up with changes in social media platforms. We require all students to connect through LinkedIn with a faculty member, but as faculty age and approach retirement, we must consider alternatives.

With retirements and faculty replacement comes changing values and differing commitments. How do you convince the new faculty that the successful community they have been hired into was created with prior goals and objectives, not just random acts? We are in that transition now, and we are taking steps to pass along these community building activities. Senior faculty are beginning to mentor rising leaders into our key leadership themes: curriculum, community, and assessment.

The changing landscape must also include the changing role of faculty. In many institutions, online education and teaching through technology reduces a key factor of community building – being together at the same time and place. These institutions need to consider this in their community building.

## 4. INGREDIENT: PEDAGOGICAL RESEARCH

At JMU, we value pedagogical research as legitimate scholarship. This includes curricular issues, studies of teaching impact, and teaching cases and tips. All of these are central to the mission of JISE. We practice the teacher-scholar model (Boyer 1990, Gardner, McGowan, and Moeller, 2010), and we believe that scholarship in pedagogy enhances the quality of our teaching, and vice versa.

However, few other top-ranked programs listed in Appendix A are as active in pedagogical scholarship as JMU. The reward structure in R1 institutions places less value on publications involving educational techniques, curriculum issues, or teaching cases and tips. The second-class status of pedagogical research is well-documented (Asarta et al. 2018, Cotton, Miller, and Kneale, 2018).

### 4.1 IS Pedagogy Publication among Top-10 IS Programs

Kruck, Mathieu, and Mitri (2013) assessed IS pedagogical research productivity between 2005 and 2010 in three IS journals with significant pedagogical content. These are *Communications of the AIS* (CAIS), *Journal of Computer Information Systems* (JCIS), and *Journal of Information Systems Education* (JISE). Of the three, only JISE is principally an IS education journal. CAIS and JCIS include educational and curricular articles, but most of their articles are non-pedagogical in nature. Whereas 100% of JISE articles are educational, only 20% of CAIS articles and 11% of JCIS articles were found to be pedagogical in nature in this study. Their article listed the top 50 institutions in terms of pedagogical research productivity in these journals. Only six of these universities are among the top-ranked schools listed in Appendix A; these are JMU (1st), the University of Georgia (14th), NJIT (23rd), Brigham Young

University (24th), Georgia State University (44th), and Northeastern University (47th).

We reviewed the JISE archives from 2010 through 2018 and found that, among the other top-ranked programs, only Indiana University, University of Maryland, and University of Illinois faculty wrote articles for JISE. Each of these schools have one JISE publication. By contrast, JMU faculty have published 13 articles in that time frame.

Our review of pedagogical CAIS articles in that time frame shows more activity from the listed top-ranked schools, including the University of Arizona, Arizona State University, Brigham Young University, the University of Georgia, Georgia State University, Indiana University, JMU, MIT, NJIT, and Villanova University. CAIS is considered a more prestigious journal in traditional IS research, so it is unsurprising that faculty from R1 institutions will be more willing to publish in CAIS than in JISE. Yet, similar to JISE, pedagogical contributions to CAIS from top-ranked programs are relatively sparse.

Most JISE contributions do not come from R1 institutions. JISE readership is likely to consist principally of teaching-focused, rather than solely research-focused, faculty. The reward structure of regional undergraduate- and masters-granting institutions like JMU tends to support and encourage pedagogical research which, when done right, enhances the quality of education in these schools.

### 4.2 Benefits of Pedagogical Scholarship

Publishing in pedagogical journals requires the researcher to study pedagogical issues and to read the academic literature in outlets like JISE. Many IS faculty with doctorates from R1 institutions did not take pedagogy-oriented coursework during their Ph.D. studies, nor did most of them engage in pedagogical research for their dissertations. For those of us who become faculty of teaching-oriented universities like JMU, doing pedagogical research allows us to become students of pedagogy and forces us to gain a deeper understanding of pedagogical theory and methods, and this helps to improve teaching. It also provides insights, examples, and ideas of what is going on elsewhere in the IS education community, a benefit familiar to all JISE readers. And it gives us an opportunity to share our methods and findings with other IS educators.

JMU CIS faculty see JISE as an important venue for our brand of scholarship. The student-focused culture of a school like JMU, combined with JISE's mission, gives our faculty an excellent opportunity to practice the teacher-scholar model.

### 4.3 Responding to the Changing Landscape

As IS education progresses in the 21st century, rapid technological changes will affect both what we teach and how we teach. It is obvious that emerging technologies, methods, and issues bring many opportunities for pedagogical research journals like JISE. Future technical teaching cases and tips can involve Python scripts using machine learning libraries, cloud-based AI and NLP services such as AWS Comprehend or Microsoft Azure Cognitive Services, use of blockchain technologies, data visualization tools, and many other available (and often free) technologies highly relevant to IS practice. Modern and emerging methodologies like SCRUM and DevOps also provide opportunities for teaching cases or tips as well as empirical research or model building. The increasing prevalence of AI and data mining in IS artifacts will make ethical questions and cases even more important for students in the coming decades.

In addition to affecting the content of our curriculum, technology will also affect the methods by which we teach about IS. For example, there are many questions about social media's place in IS education to explore, and studies relevant to this topic are perfect fodder for JISE and other pedagogical outlets. Flipped classrooms, online hybrids, and other technology-enabled teaching methods are all fruitful areas of educational research. These are only a few examples of possibilities for future JISE articles.

## 5. INGREDIENT: COMMITMENT TO CONTINUOUS IMPROVEMENT AND ASSESSMENT

The next ingredient of a quality program is a strong culture of assessment with continuous improvement. Assessment done well becomes "the driving force behind program improvement" (Murray, Pérez, and Guimaraes, 2008, p. 198). In good assessment, a program defines its own objectives, measures student performance against these objectives, and then improves the curriculum to improve student performance (Reichgelt and Yaverbaum, 2007; Jacobson et al., 2011). Most importantly, student performance is re-measured after the improvement to see if the intervention was truly an improvement leading to a cycle of continuous improvement (Fulcher et al., 2014.) Without that final measurement, assessment can become measurement for the sake of measurement and does not lead to learning improvement. Modern accreditation requires good assessment with continuous improvement. This is part of both ABET accreditation and AACSB accreditation for IS programs in a business school like JMU.

JMU has won numerous awards for its assessment practices. There is a center for assessment and research studies, graduate programs in assessment, and staff and graduate students who assist programs with assessment. The university requires that each academic program have an assessment leader who is responsible for reporting annually on assessment and continuous improvement. These assessment reports are evaluated, and evaluations with suggestions for improving assessment are shared annually with the program. The evaluation is also shared with college and university leadership. Thus, there is strong institutional encouragement and support for doing assessment correctly. Senior faculty leaders in the department began a strong effort to improve assessment and guarantee it was used for continuous improvement. Our efforts stressed faculty participation, teamwork, and collaboration (also suggested as assessment best practices in Kim et al., 2012.)

### 5.1 How We Assess

Assessment measures can include indirect measures such as surveys or focus groups or direct measures such as exams. The best assessments include multiple, complementary techniques (Jacobson et al., 2011.) At JMU, our efforts include direct and indirect measures for assessment.

**5.1.1 Direct assessment.** Direct assessment is assessment that is based upon actual student work, such as exams, projects, or homework. Some examples from JMU's program are:

- Course-embedded assessments in each required course
- Program-level assessment of students pre- and post-program using an assessment exam developed by the faculty teaching within the program (for details on this exam, see Lending (2014))
- Program assessment on requirements elicitation which involved changes across the curriculum to improve students' ability to conduct requirements elicitation (for more details on this project, see Ezell et al. (2019) and Lending et al. (2018))

**5.1.2 Indirect assessment.** Indirect measures of assessment are based upon measures that are not direct and include surveys and focus groups. We use two types of indirect measures:

- Web-based surveys of graduating seniors
- Surveys of alumni (for details, see Lending and Mathieu (2010))

The efforts have been successful, with the CIS program being evaluated as exemplary in assessment by the JMU assessment office each year since evaluation of assessment began, receiving the Provost's Award for Excellence in Assessment in 2017, and senior faculty speaking at numerous conferences about our assessment program. Most importantly, we see continuous improvement in student learning in the program.

### 5.2 What has made the Assessment Efforts Successful?

As we look back on our assessment efforts, we consider several factors that have made the assessment successful:

**5.2.1 Strong faculty leadership.** Jacobson et al. (2011) write that strong faculty leadership is a critical ingredient for successful assessment. As we built the culture of assessment in the program, we had two successive senior faculty assessment leaders who were able to motivate and persuade faculty to participate. They organized the assessment process to keep it on track year after year. They built the collaborative nature of assessment as described in section 5.2.2. And, each required course had a course coordinator or leader who made sure that the objectives of each course section were the same and that assessment was discussed across sections and instructors.

**5.2.2 Collaboration with a strong element of trust.** Assessment in the CIS program is a team effort. Faculty teaching the same course work together to develop embedded assessment and assessment test questions. Faculty teaching different courses work together to develop objectives that build on one another and are assessed in the assessment exam. But most importantly, to use assessment for improvement, faculty members must be willing to admit that their practices might need improvement. One way to build trust is to have senior faculty willing to admit that they tried learning activities that did not work. Additionally, assessment results are used only to improve student learning and never for faculty evaluation. The faculty community is founded in trust.

**5.2.3 Faculty buy-in.** All faculty teaching in the program must contribute to assessment. Again, having faculty lead the effort helps in motivating assessment. Moreover, the results of continuous improvement become self-motivating as faculty see their efforts leading to successful student achievements and improved student learning. Finally, it is fun to work with other faculty on improvement. Discussing objectives, assessment, and results is part of the culture and has become a building block of our department community.

**5.2.4 Department, college, and university support.** Faculty leadership of assessment must be supported. The assessment leaders have been recognized and rewarded by the department, college, and institution for assessment practices and leadership, thus encouraging them to spend the time needed for good assessment. JMU also encourages pedagogical research allowing both assessment leaders to write about and use their efforts in their research.

**5.2.5 Accreditation requirements.** As Section 6 describes, modern accreditation requires assessment to be done well with demonstrated continuous improvement.

### 5.3 Responding to the Changing Landscape

As a program adjusts its curriculum to keep up with the changing landscape, the faculty must also adjust assessment and continuous improvement to keep it a part of the culture. With curriculum alterations come assessment alternations, and it can be a difficult task to align all assessment instruments. These alterations make it harder to compare assessment results year after year, but without the alterations, assessment results become meaningless. For example, at JMU we changed the programming language taught in our introductory programming course from Visual Basic to Python. The assessment exam had to be changed to reflect the new language and, in the years immediately following the change, results of student performance could no longer be compared before and after the change.

A second challenge is to continue to have faculty buy-in to assessment as newer faculty join the department and older faculty leave. Assessment, as done in JMU's CIS program, requires faculty leadership and thus newer faculty to step up and own their course and the assessment required. The challenge is to grow the middle leadership described in the community ingredient in section 3.

## 6. INGREDIENT: ACCREDITATION

A final ingredient of a successful program is accreditation providing a mark of quality from an outside entity. In the United States, accreditation is optional. An IS program based in a college of business may be part of three accreditations: a regional accreditation of the university, accreditation of the college, and accreditation of the program. ABET accreditation is the only accreditation available for an IS program (Reichgelt and Yaverbaum, 2007). Topi (2016, p. 21) strongly recommends ABET accreditation saying

> if your undergraduate IS program is looking for a way to differentiate itself, enforce continuous improvement processes, and connect with the worldwide community

to quality-focused computing programs, we strongly recommend that you and your colleagues start to explore the benefits of computing accreditation.

JMU's CIS program began the ABET accreditation process in 2003. For details on the ABET Accreditation process, see Appendix B.

### 6.1 Benefits of ABET Accreditation for an IS Program

Accreditation provides an external validation of program quality to outsiders, including the IS community, students, employers, the state, and the institution as a whole (Challa, Kasper, and Redmond, 2005; Jacobson et al., 2011). That sign of quality provides real benefits to the program.

**6.1.1 Preparing for accreditation.** The preparation for accreditation forces the program to perform self-reflection (Topi, 2009). For JMU, it started with faculty working together to rethink the curriculum. What were the outcomes that we wanted students graduating from the program to be able to do? Where did we see graduates of the program in five years? After working on the big picture, faculty within subareas worked together across courses. For example, the programming faculty worked together on developing outcomes across the programming courses. Courses built on one another. Another benefit is that ABET evaluators provide feedback on outcomes and objectives (Topi, 2016). This guidance was instrumental in our self-reflection. We feel that faculty members working together and discussing curriculum improves the curriculum. When we found weaknesses, we had to address them.

**6.1.2 Engaging with stakeholders.** ABET accreditation requires working with stakeholders on defining the program, the curriculum, and the outcomes. The JMU program reactivated an advisory board which had gone dormant. The board included employers of our graduates, alumni, and other stakeholders of the program. The advisory board became an active participant in strategic planning, curriculum review, and outcome definition. We were able to get feedback from the advisory board on questions such as:

- Should our program continue to include a second programming class? What language should be taught in the programming classes?
- What were the strengths of our graduates? Where do they stand out in comparison to their peers from other programs?
- What were the weaknesses of our graduates?

This guidance helps shape our curriculum choices and guarantees that our graduates have many job opportunities. Listening to our advisory board also becomes a feedback loop for the advisory board to continue to participate.

**6.1.3 Focus on resources.** ABET accreditation provides guidance on necessary resource levels and gives IS programs support in working with upper administration on needed faculty lines, computer laboratories, etc. (Topi, 2016). For example, ABET evaluators gave the JMU CIS program supporting evidence that our computer labs needed to be expanded and upgraded.

**6.1.4 Outcomes based on objectives.** Modern accreditation is outcome-based where the program defines its own objectives (Reichgelt and Yaverbaum, 2007; Jacobson et al., 2011), assesses those objectives, and looks for continuous improvement. The benefits of assessment are discussed in Section 5. This benefit reminds us that the major reason behind accreditation is to improve the quality of the IS education (Topi, 2009).

### 6.2 Costs of ABET Accreditation

As of October 1, 2018, just 40 IS programs were ABET-accredited (ABET-Accredited Programs, 2019). As mentioned in Section 2, only two (JMU and NJIT) of the top IS programs are ABET accredited. MacKinnon, Elder, and Dyer (2016) point out that while there has been a growth in the number of accredited IS programs, that growth has been very slow and has reached "a virtual halt" (p. 22). Challa, Kasper, and Redmond (2005) point out the tangible and intangible costs of accreditation. Beyond the actual application fee and visit expenses, these include changes in what the program does, changes in curriculum, and redirecting faculty time (Challa, Kasper, and Redmond, 2005). ABET accreditation must be faculty-driven for success and must have a strong faculty leader in charge of accreditation and the self-study. The costs of that can be considerable.

Perhaps the major issue with ABET accreditation is the prescriptive nature of the accreditation. As described in Table B.1 of Appendix B, line 3, as of 2019, an IS program must adopt the six ABET IS outcomes (objectives). The program can have additional outcomes, but those six must be adopted, published, and assessed. If these required outcomes match the wishes of the faculty, that is acceptable, but if not, accreditation is not a wise choice. Table B.1, line 5 shows that the curriculum for the program must include 30 credits of basic and advanced IS topics, including application development, data management, networking and data communications, security of information systems, systems analysis and design, and the role of information systems in organizations. Thirty credits are more than many programs have room for, so this is, again, a significant barrier. Second, this prescribes networking and security; again, choices that an MIS program might have chosen to not include. Finally, a program with a focus on business analytics or security might not include basic and advanced application development.

### 6.3 Responding to the Changing Landscape

Accreditation is not for every program, and many programs choose not to try. For JMU in the early 2000s, the advantages outweighed the costs, and accreditation led to significant improvements in the program. It also led to a culture of faculty discussing curriculum with each other and with other stakeholders, which led to program improvement. However, continuing to seek ABET accreditation at JMU could restrict our future. JMU added a business analytics minor to our curriculum in 2012. The minor has been successful, but in discussions with our faculty and advisory board, the need for more courses in business analytics grows. As discussed in Section 2.4, multiple approaches to integrating business analytics with the CIS major are being considered, including encouraging the minor, creating a concentration within the major, and creating a new major. At the moment, creating a business analytics concentration in the major seems to be the best choice. That would require removing some CIS courses and adding some business analytics courses to the concentration. If we move in that direction, we would have to consider whether that concentration could prevent us from being reaccredited, since ABET requires that all students in a major meet ABET curriculum requirements. ABET may change the requirements in the meantime, making it easier, but this is something we need to monitor.

A similar challenge is that our employers are also seeking students with information security skills. Our current program integrates information security issues into several required courses, and we have security electives. That is not a strong enough focus for a career in security. We considered adding a separate major in Cybersecurity, but, again, staffing needs and state approval could get in the way. ABET accredits programs named Cybersecurity separately from programs named Information Systems, and they have different criteria. Now, we are considering security as a separate concentration in the CIS major, removing some CIS classes, and adding security classes. Again, we need to consider whether the security concentration could prevent us from being reaccredited.

## 7. CONCLUSION

In this paper, we discuss James Madison University's undergraduate major in Computer Information Systems and the ingredients that made it a high-quality IS program: (1) building an integrated, rigorous curriculum with a strong technical foundation; (2) developing a vibrant community of faculty, students, alumni, employers, and friends; (3) committing to continuous improvement and assessment; (4) learning from and writing pedagogical scholarship; and (5) ABET accreditation. It took many years and much effort from our entire community to become a high-quality program. There is no end to this work. The IS industry, IS education, and education in general continue to change, and we will face challenges to meet the new landscape.

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## APPENDIX A: CHARACTERISTICS OF TOP-RANKED INFORMATION SYSTEMS CURRICULA

In an effort to identify characteristics of high-quality undergraduate IS programs, we analyzed websites and 2018-2019 course catalogs of the top 10 programs from (a) College Factual Computer Information Systems rankings, (b) College Factual Management Information Systems rankings, and (c) U.S. News & World Report Undergraduate Management Information Systems rankings. These universities are, in alphabetical order: University of Arizona, Arizona State University, Brigham Young University, Carnegie Mellon University *, Cornell University, University of Georgia, Georgia State University, Georgia Tech University *, Georgetown University, University of Illinois, Indiana University, James Madison University, Johns Hopkins University, University of Maryland*, MIT, University of Minnesota, New Jersey Institute of Technology, New York University *, Northeastern University, University of Notre Dame, University of Pennsylvania, Rochester Institute of Technology, Saint Joseph University, University of Texas at Austin, Villanova University, Washington University, and Worcester Polytechnic Institute. Asterisked schools are in both U.S. News and College Factual top 10 rankings. The list contains 27 universities (see Table A.1).

A few caveats about rankings. Neither College Factual nor U.S. News give a description or analysis of the program itself on their website, only of the university. Sometimes it is unclear just what program within the university a ranking is for. For example, MIT is ranked #1 in U.S. News for undergraduate MIS majors, but it does not appear to have an undergraduate program resembling what most people think of as IS. College Factual ranks Johns Hopkins University 10th in CIS, but the catalog shows no undergraduate major in IS, although there is a Master's IS program. Saint Joseph University is listed 9th in College Factual MIS, but a search for an undergrad IS program also gives no results. Both MIT and Saint Joseph University have undergrad business analytics programs, but these are much more quantitatively based than a typical IS program, and do not cover much IS-related content. MIT's course catalog includes graduate courses in "Information Technologies," offered by the Sloan Business School, which are principally economic and managerial in nature. St. Joseph University's Computer Science department includes an "Information Technology" major consisting of several computers science courses with two additional accounting courses. Neither of these programs correspond with what most people would consider to be an undergraduate information systems program. Because of this, we decided to eliminate MIT, Saint Joseph University, and Johns Hopkins University from most of the analysis, and to include Arizona State University, University of Georgia, and Northeastern University (#11 rankings in each list) among the top-ranked schools.

Another caveat relates to the classifications of IS, CIS, and MIS (or variants). Among the programs listed above, eight are named Information Systems, nine are Management Information Systems, and three are Computer Information Systems. Other names include IS Management, Operations and Information Management, Information Technology Management, and Information Science, Systems, and Technology. U.S. News calls its rankings MIS. College Factual distinguishes between a CIS list and an MIS list, but it is unclear from looking at the programs in these lists why a program is put into one versus the other. Furthermore, the descriptions of the majors are often ambiguous and sometimes just plain wrong. For example, College Factual states that CIS curriculum includes robotics and numerical analysis (Computer Information Systems Overview, 2013), which are rarely if ever found in a core IS curriculum. Business Week does a slightly better job of describing MIS when displaying their online MIS rankings

"Management information systems is a multidisciplinary field that integrates concepts in information technology with the primary principles and methods of business and management. Graduates with a management information systems bachelor's degree can pursue a wide range of roles in the information technology sector, including IT manager, systems administrator, software engineer and business systems analyst." (Online Bachelor's Degree in Management Information Systems, 2019).

Third, it is important to keep in mind the different ranking methodologies of the two organizations. U.S. News rankings are based on social mobility, graduation and retention rates and performances, faculty resources, peer review, financial resources, factors related to the quality of students entering the university, and alumni giving (McWilliam, 2014). College Factual methodology is based on graduate earnings, factors related to the major's impact and relationship with the university as a whole, accreditation, and overall school quality (Morse, Brooks, and Mason, 2018.)

| | US News Top 10 Undergrad MIS | College Factual Top 10 CIS | College Factual Top 10 MIS |
|---|---|---|---|
| 1 | Massachusetts Institute of Technology | New Jersey Institute of Technology | University of Notre Dame |
| 2 | Carnegie Mellon University | Georgia Tech University | University of Washington |
| 3 | University of Arizona | Carnegie Mellon University | Georgetown University |
| 4 | University of Texas at Austin | University of Pennsylvania | Worcester Polytechnic Institute |
| 5 | University of Minnesota | James Madison University | Brigham Young University |
| 6 | Georgia Tech University | New York University | Rochester Institute of Technology |
| 7 | Indiana University | University of Washington | Villanova University |
| 8 | University of Maryland College Park | Cornell University | University of Illinois |
| 9 | Georgia State University | University of Maryland | Saint Joseph University |
| 10 | New York University | Johns Hopkins University | University of Texas at Austin |
| 11 | Arizona State University | Northeastern University | University of Georgia |

**Table A.1. Top-Ranked Programs from each Ranking**

With these caveats in mind, we investigated the program descriptions and course catalogs for these undergraduate majors in some depth. Details on the courses are shown in Table A.2. Excluding MIT, Johns Hopkins, and Saint Joseph (for reasons mentioned above), most programs follow a more-or-less "traditional" theme, and most are housed in a business school. A few are more eclectic, such as Carnegie Mellon, Cornell, Georgetown, and NYU. CMU's IS major is housed in a college of information systems and public policy. Cornell has three "Information Science" majors; the one closest to "information systems" is housed in a college of engineering. NJIT's IS program is in a college of computing, within an informatics department. NYU's IS Management major is within the school of professional studies. For IS programs in non-business colleges, the required business core does not take up credit hours, so some of these are able to require more major courses than the norm. Typically, the number of required courses is five or six, with an additional 2-3 major electives. There is a wide range in both numbers. For example, Pennsylvania's program (which is just a track, not a major) has no required IS courses, just three electives. Northeastern's program is a concentration with two required courses and two electives. At the other extreme, NJIT has 13 required courses specific to the major, and Brigham Young has 10. The mode and median of required courses all programs are both five. The mode and median of the elective courses are both 2, making a typical total of seven courses (beyond introductory IS.)

| | | | Number of required courses on a topic | | | | | |
|---|---|---|---|---|---|---|---|---|
| **University** | **Major Name** | **#Courses in Major** | **PGM** | **DB** | **SAD** | **Network/ Arch** | **Other** | **Required Capstone** |
| Arizona | MIS | 6 required<br>2 electives | 1 | 1 | 1 | 1 | Operations | |
| Arizona State | CIS | 7 required | 0 | 1 | 2 | 0 | Security<br>Web<br>Mobile | 1 |
| Brigham Young | IS | 10 required | 2 | 1 | 1 | 1 | Web/ERP<br>Security<br>Analytics/BI<br>Project Mgt | 1 |
| Carnegie Mellon | IS | 8 required<br>1 elective | 3 | 1 | 0 | 0 | Consulting<br>Info Systems Milieux | 1 |
| Cornell [c] | Info Science, Systems, and Technology | 13 required<br>2 electives | 2 | 0 | 1 | 1 | Analytics/BI<br>Social/Ethics<br>UI/UX | |
| Georgetown | Operations & Info Mgt (Managerial Computing) | 3 required<br>3 electives | 2 | 0 | 0 | 0 | Analytics/BI | |
| Georgia | MIS | 6 required<br>1 elective | 1 | 1 | 1 | 0 | Project Mgt<br>Bus Proc Mgt<br>Web Devt | |
| Georgia State | CIS | 5 required<br>2 electives | 1 | 1 | 1 | 0 | Project Mgt | 1 |
| Georgia Tech | IT Mgt | 3 required<br>3 electives | 1[b] | 1 | 1 [b] | 0 | Project Mgt [b] | |
| Illinois – Urbana-Champaign | IS | 3 required<br>6 electives | 0 | 1 | 1 | 1 | | |
| Indiana - Bloomington | IS | 5 required<br>3 electives | 1 | 1 | 1 | 1 | Managing IS | |
| James Madison University | CIS | 8 required<br>2 electives | 2 | 1 | 1 | 2 | Cloud Server Mgt (1 credit) | 1 |
| Maryland - College Park | IS | 4 required<br>2 electives | 1 | 1 | 1 | 0 | | 1 |
| Minnesota | MIS | 7 required<br>2 electives | 2 | 1 | 1 | 0 | Strategy<br>ERP | 1 |
| New Jersey Institute of Technology | IS | 13 required<br>3 electives | 1 | 1 | 2 | 1 | Project Mgt<br>Analytics/BI<br>Web (2)<br>Social/Ethics/ UI/UX (2) | 1 |

| | | | Number of required courses on a topic | | | | | |
|---|---|---|---|---|---|---|---|---|
| **University** | **Major Name** | **#Courses in Major** | **PGM** | **DB** | **SAD** | **Network/ Arch** | **Other** | **Required Capstone** |
| New York University | IS Mgt | 6 required<br>9 electives[c] | 1 | 1 | 1 | 1 | Project Mgt | |
| Northeastern | MIS (track) | 2 required<br>2 electives | 0 | 1 | 0 | 0 | Business-Systems-Integration | |
| Notre Dame | MIS | 7 required<br>1 elective | 1 | 1 | 1 | 2 | Security<br>Ethics<br>Project Mgt | |
| Pennsylvania | IS (track) | 0 required<br>3 electives | 0 | 0 | 0 | 0 | | |
| Rochester Institute of Technology | MIS | 4 required<br>2 electives | 1 | 1 | 1 | 0 | | 1 |
| Texas - Austin | MIS | 5 required<br>2 electives | 1 | 1 | 1 | 0 | Strategy<br>Web | |
| Washington | IS | 5 required<br>1 elective | 1 | 1 | 1 | 1 | Analytics/BI | |
| Villanova | MIS | 2 required<br>4 electives | 1 [d] | 1[d] | 1 | 0 | | |
| Worcester Polytechnic Institute | MIS | 5 required<br>3 electives | 2 | 1 | 1 | 1 | | 1 |

**Table A.2. Program Details of Top-ranked Schools; Identifies Required Courses in Programming (PGM), Database (DB), Systems Analysis (SAD), Networking and/or Architecture, Other, and Capstone.**

Table A.2 notes:

This table identifies required courses in programming (PGM), database (DB), systems analysis (SAD), networking and/or architecture, other, and capstone.

Introduction to IS courses are not included in these totals, since they are assumed to be required of all business students. Required programming courses from outside IS (e.g. computer science) are included in the totals.

[a] Cornell's program is in college of engineering and has options which may not map into traditional IS curricula.
[b] Georgia Tech requires two from a cluster of three courses: programming, SAD, and project management.
[c] NYU requires five courses from a cluster of 12 options; we count these as electives here.
[d] Villanova requires two from a cluster of three courses: programming, database, and SAD

## APPENDIX B: ABET ACCREDITATION

ABET was originally short for the Accreditation Board for Engineering and Technology programs but now is known only by its initials. It began as accreditation for engineering and technology programs but expanded to accredit computer science programs and IS programs under the Computing Accreditation Commission (CAC). In order to be ABET accredited, an IS program must demonstrate that it satisfies the ABET defined criteria for computing programs in general and for an IS program as shown in Table B.1.

Technically ABET accreditation is an 18-month process that begins when a program begins a self-study and requests accreditation. However, the program must begin the planning process long before that by adopting the ABET framework. Figure B.1 shows the steps that go into ABET planning (Assessment Planning, 2019).


**Figure B.1. Assessment Planning**

Once a program feels that they are ready for accreditation, the formal 18-month process for accreditation can begin. This process crosses two academic years (indicated by year 1 and year 2 in Figure B.2.) The formal process starts with a request for evaluation prior to January 31st in the first academic year and ends with formal notification in August of the second academic year. However, the self-study year where the program collects syllabi, samples of student work, textbooks, etc. begins at the beginning of the first academic year (Accreditation Step-by-Step, 2019). The steps are shown in Figure B.2.

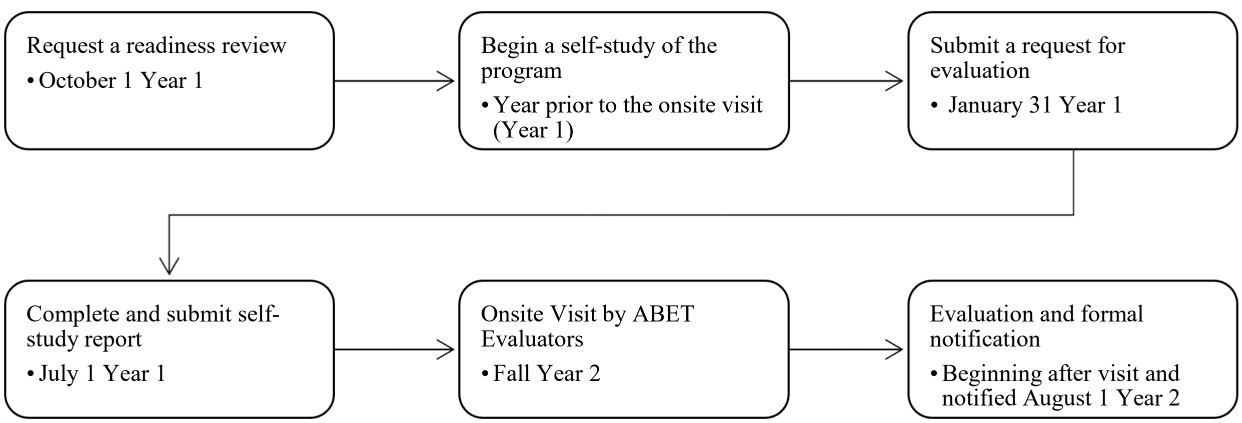


**Figure B.2. Accreditation Process**

| Criterion | General Criteria for Accrediting Computing Programs | Additional Program Criteria for Information Systems Programs |
|---|---|---|
| 1. Students | Student progress and performance must be evaluated and monitored. Students must have a path to graduation including advising, acceptance, transferring, and graduation requirements. | |
| 2. Program Educational Objectives | ABET defines Program Educational Objectives (PEOs) as "broad statements that describe what graduates are expected to attain within a few years after graduation. (p.2)" The program must have clearly defined PEOs and a process for defining them. The process must include consultation with stakeholders as defined by the program. | |
| 3. Student Outcomes (The ABET terminology refers to student outcomes but these are often called objectives or goals in other contexts.) | Students Outcomes are what students are expected to be able to do by the time of graduation. The program must have clearly defined outcomes that prepares students to attain the PEOs. There also must be a process for review and revision of the outcomes. Through 2018-2019 reviews, a program could adopt any outcomes as long as their outcomes enabled the ABET required abilities (though many programs chose to adopt ABET abilities as their outcomes.)<br><br>Beginning with 2019-2020, a program's outcomes must include the ABET outcomes:<br><br>Graduates of the program will have an ability to:<br>1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.<br>2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.<br>3. Communicate effectively in a variety of professional contexts.<br>4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.<br>5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline. | In addition to outcomes 1 through 5, graduates of the program will also have an ability to:<br><br>6. Support the delivery, use, and management of information systems within an information systems environment. |
| 4. Continuous Improvement | ABET requires that programs assess all outcomes and use the results of assessment for continuous improvement. The process for continuous improvement must be documented. | |
| 5. Curriculum | ABET requires that the program's curriculum combines technical and professional requirements in preparing students for a professional career. The curriculum must be consistent with the PEOs and Student Outcomes. | 1) The IS curriculum must include at least one year (30 credits in a semester program) of fundamental and advanced computing topics:<br>• Fundamentals must include application development, data management, networking and data communications, security of information systems, systems analysis and design, and the role of Information Systems in organization.<br>• Advanced course work that builds on the fundamentals to provide depth. |

| Criterion | General Criteria for Accrediting Computing Programs | Additional Program Criteria for Information Systems Programs |
|---|---|---|
| | | 2) The curriculum must include one-half year (15 credits) in a cohesive set of topics that provides an understanding of the environment in which the information systems will be applied professionally. For example, an IS program in a business school could have at least 15 credits of business courses such as accounting, marketing and management; while a Health IS program would require at least 15 credits of health- related courses such as health services administration.<br>3) The program must have course work in quantitative analysis including statistics. |
| 6. Faculty | The faculty members teaching in the program must have the expertise and educational background to cover the curriculum. There must be sufficient faculty to maintain continuity, provide oversight, and advise the students. The faculty must have the responsibility and authority to improve the program and define PEOs and student outcomes. | Some full-time faculty members must hold a terminal degree in information systems. The faculty responsible for the IS curriculum must include some of these faculty members. |
| 7. Facilities | Classrooms, offices, and computer laboratories must be adequate to attain student outcomes. They must have modern equipment and software appropriate for the program. | |

**Table B.1. ABET 2018-2019 Criteria for IS Programs (ABET 2019)**

Information Systems & Computing
Academic Professionals

EDSIG
Serving Information Systems Educators

## STATEMENT OF PEER REVIEW INTEGRITY

All papers published in the Journal of Information Systems Education have undergone rigorous peer review. This includes an initial editor screening and double-blind refereeing by three or more expert referees.



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