

Evaluation of Information Systems Curricula

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ABSTRACT

Information systems education objectives must continually adapt to a dynamic marketplace for knowledge and skills. For faculty developing programs that better prepare students for this demanding environment, existing research and guidelines provide a foundation to develop relevant coursework. However, an examination of peer institutions indicates a significant variance in how institutions of higher learning address the requirements of local markets as they prepare their students for careers. This study reviews previous information systems curricula research, examines current guidelines for information systems education, analyzes adherence to those guidelines, and summarizes innovative approaches being used by business colleges in the U.S. to prepare students. Our findings indicate that even as the number of information systems programs decline, colleges are looking for relevant ways to serve their students and communities. For information systems education to remain connected to the marketplace, the value provided by a degree in information systems must be clear to future employers. This paper concludes by offering insights gained by an analysis of thriving programs to assist faculty working on improving their undergraduate information systems curriculum.

Keywords: Advisory boards, Curriculum design & development, IS major, Learning goals & outcomes

1. INTRODUCTION

The study of information systems (IS) requires students to bridge two extensive bodies of knowledge: the understanding and management of information technology (IT) and the understanding and application of business processes and practices. The adage “Jack of all trades, master of none” comes to mind as IS students prepare for careers in the “real world” and study IS topics, such as system development, cybersecurity, database management, and web site design, while simultaneously attempting to study and master business subjects like accounting, finance, human resources, marketing, and management. An effective Management of Information Systems (MIS) education program should provide the specific IS knowledge, skills, and abilities desired in an ever-evolving market. Significant curriculum changes, while not impossible, take time to be approved and require considerable effort by the faculty and staff to develop and continually update for relevance. Concerns with IS curriculum design are of vital importance and of current interest to IS program leadership as shown in recent academic literature (Fichman et al., 2014; Agarwal and Ahmed, 2017; Yang, 2018; Yin, Tan, and Nakata, 2018; Case and Tabatabaei, 2019; Ezell et al., 2019).

Employment opportunities, as listed on the Computer and Information Technology Occupations page on the U.S. Bureau of Labor Statistics, are projected to grow 13% faster than the

average for all occupations (U.S. Bureau of Labor Statistics, 2018), and many of the occupations require a computer or IS Bachelor’s degree. More advanced opportunities require work-related experience; but in some cases, candidates with an associate degree or postsecondary classes may qualify for a position. However, despite recent news stories to the contrary, a college education still provides a significant return on investment (Oreopoulos and Petronijevic, 2013), especially in science, technology, engineering, and math (STEM) related careers. Regardless, the occupations discussed in this article require specialized knowledge and skills (e.g., programming languages, computer networking, database administration), resulting in a debate of education versus training and training in which technologies provide the best foundation in a dynamic environment. With limited resources, and within the constraints of a 120-hour undergraduate degree, finding the right balance between business and technology, education and training, and hard skills and soft skills is essential as institutions of higher education prepare IS students for successful careers after graduation. Fortunately, guidance exists to help in this quest for answers.

There are established guidelines from recognized IS discipline sources such as the Association for Information Systems (AIS) as well as recent research to help guide this examination. First, ample justification has been provided for the continuous review of program curricula as summarized by

Mills et al. (2012). Secondly, accreditation bodies (e.g., the Association to Advance Collegiate Schools of Business (AACSB)) provide specific guidance on questions relating to curricula development explored in this paper. Finally, industry feedback on the knowledge and skills that they need for continued growth of their enterprise grounds the discussion in real-world demands. As an AACSB accredited institution that is considering an expansion to a four-year degree program, but currently offering only an IS concentration, we asked the following questions:

1. What are the current guidelines for an effective IS program?
2. Is there a market need for IS education and related topics?
3. How are peer institutions responding to the market needs and suggested guidelines?

Following a review of relevant literature, this study presents an analysis of existing IS undergraduate programs in the U.S. followed by a discussion of recommended courses to consider in developing an IS undergrad bachelor's degree program. The conclusion of this article includes insights into topics for additional research and suggestions for the implementation of curriculum changes.

2. LITERATURE REVIEW

A review of existing research on the subject indicates that IS curriculum development and improvement processes are important subjects for discussion. Establishment and adherence to IS Model Curriculum Guidelines have received a great deal of attention, and accreditation bodies ensure that member institutions can demonstrate curriculum review and development processes. We start with a review of existing IS curriculum research and briefly discuss accreditation agency issues to establish a framework for this research.

2.1 IS Model Curriculum Research

Bell, Mills, and Fadell (2013) offer a summary of previous versions of IS Model Curriculum Guidelines. Given that this paper is a partial replication of their research, we will not repeat their research here. The portion of Bell, Mills, and Fadell's (2013) research that is of interest to this study relates to the adherence to the IS 2010 Curriculum Guidelines. Table 1 summarizes the core courses based on the catalog descriptions provided by Topi et al. (2010).

Mills et al. (2012) examined 127 AACSB IS programs and identified 4 IS program profiles depicting adherence to the IS Model Curriculum: Independent – low adoption; Focused – some adoption, offset with focus on another area (e.g., Data Analysis); Adoptive – high adoption; and Flexible – more reactive to local realities. The authors used their results to update the state of IS education and found that there is justification for both adopting the IS Model Curriculum and for customizing as needed due to "...the rapid pace at which the IS discipline evolves relative to other disciplines" (Mills et al., 2012, p. 425).

Core Course	Brief Description
IS Foundations	Introduces students to contemporary IS and demonstrates how IS are used throughout global organizations.
Data and Information Architecture	Introduces students to the core concepts in data and information management.
Enterprise Architecture	Introduces students to the design, selection, implementation, and management of enterprise IT solutions.
IT Infrastructure	Introduces students to the IT infrastructure issues, focusing on service and capabilities, including network security, business continuity, and regulatory compliance.
IS Project Management	Introduces students to the processes, methods, techniques, and tools used to manage IS projects.
Systems Analysis and Design	Introduces students to the analysis of business needs, specifying requirements to address those needs using IS.
IS Strategic Management	Introduces students to the issues and approaches to managing IS to support organizational capabilities.

Table 1. IS 2010 Core Course Descriptions Used for Data Collection

2.2 Accreditation Association Guidance

A process for continuous review and improvement of curricula is often a specific focus for accrediting associations. Accreditation is a process that ensures that acceptable levels of quality instruction are maintained at institutions of higher learning by adherence to standards established and reviewed by peer institutions. An examination of the U.S. Department of Education Database of Accredited Postsecondary Institutions and Programs indicated that in 2018 there were 30,804 accredited postsecondary institutions and programs in the United States, currently accredited by 22 different institutional and 40 program agencies (U.S. Department of Education, 2018). Kung, Yang, and Zhang (2006) discuss alternative accrediting bodies, including the Association to Advance Collegiate Schools of Business (AACSB), the European Quality Improvement System (EQUIS), and the Accreditation Board for Engineering and Technology (ABET). Curiously, AACSB is not one of the listed, federally recognized accrediting agencies, perhaps due to its international scope. However, AACSB accreditation is important to business schools, and filtering for AACSB schools in the United States would allow a longitudinal comparison of results.

2.3 Matching the Curricula to Need

It is essential that curricula match the needs of the potential employers of our graduates. However, the core guidelines are meant to help IS programs go beyond the needs of local employers (Topi et al., 2010). The core may also be viewed as requiring different emphases by career track (Bell, Mills, and Fadell, 2013). An exhaustive search of recent literature and educational data indicates that there have been periods of declining IS programs and enrollment, particularly during the challenging declines of 2004-2010, that led to concerns with

avoiding declines in the future by IS program administrators (Burns et al., 2014, 2018; Bowman, 2018; Case and Tabatabaei, 2019). The reported percentage of CIS/MIS programs that offered undergraduate degrees from AACSB accredited schools declined from 48% in 2011-12 to 36.8% in 2017-18 (AACSB, 2012-2019). As the percentage of IS programs in business schools decline, there is also a need to continually monitor the focus of curricula, to evaluate how those curricula meet the increasing needs of industry, and to attract student enrollment (Koch et al., 2010; Stefanidis and Fitzgerald, 2010; Burns et al., 2014, 2018; Li, Zhang, and Zheng, 2014; Bowman, 2018). This led to the specific question of whether curricula were responding to industry and IS recruitment needs.

Burns et al. (2018) attempted to evaluate job postings to assess curricula fit. Their research indicated that "experience" was listed on many web advertisements, raising the question of whether practical experience should be a focus of IS curricula. Research findings on the importance of internships have been mixed. One study (Fang et al., 2004) found no correlation between internship experience and job offers in quantity or starting salary differences. However, two other studies found that internships increased both job opportunities (Fang and Lee, 2005) and starting salaries (Sandvig, Tyran, and Ross, 2005). Fang and Lee (2005) found that IS students with internships received approximately three times more job offers than those without internships. This result was based on a slightly different sample than the research led by Fang et al. (2004). Sandvig, Tyran, and Ross (2005) found that internships were the most critical factor in predicting starting salary for IS graduates and that internships were particularly crucial in weak job markets. Based on the longitudinal nature of Sandvig, Tyran, and Ross' (2005) work, we collected data regarding the requirement of internships or other practical experience.

Security does not appear to have been widely required in IS curricula (Hwang, Ma, and Wang, 2015). However, it takes little effort to find examples of recent security breaches. While Harris and Patten (2015) discussed the increasing pressure on programs to produce graduates with better security knowledge and skills, they also noted some of the challenges of offering a course in security. Knapp, Maurer, and Plachkinova (2017) explored the use of professional certifications to guide a cybersecurity curriculum. While an IS degree curriculum would not have the available hours for many courses, perhaps the fundamentals of the professional certification might offer an outline of material to bridge the gap. Ciampa and Thrasher (2016) discussed distributing security training and instructions across all the courses in a Business Data Analytics program. Introducing parts of security across several courses in the curriculum is an interesting idea, although control of content might present a challenge.

Declining IS enrollments have inspired the need to use curricula design to increase enrollments and ensure the health of the program by aligning the program to match the needs of other departments so that courses can be made electives or core requirements for different majors (Koch et al., 2010). Business analytics is an increasing topic of interest in academia that overlaps into IS requirements (Urbaczewski and Keeling, 2019), potentially increasing enrollments in courses such as programming and database which are vital components for many analytic certifications. Additionally, analytical skills are required by many IS positions (Burns et al., 2018), leading to

the question of how many programs now feature business analytics within business schools.

Based on the preceding literature review, the following research questions were formulated for AACSB business schools:

1. Is there a market demand for IS program graduates?
2. Are MIS programs following the 2010 AIS Guidelines?
3. How are peer institutions responding?
 - a. Are certain IT/IS subjects emphasized?
 - b. Is there an emphasis on technical skills or strategic management?
 - c. Does the curriculum emphasis differ by geographic region?
 - d. Is there an emphasis on practical experience?
 - e. Do existing IS curricula emphasize security?
 - f. Is there an emphasis on data analytics?

3. RESEARCH METHODOLOGY AND DATA COLLECTION

The population for this study was undergraduate programs at U.S. schools that are AACSB accredited. Given the nature of this study as a replication and longitudinal follow up of two previous studies (Mills et al., 2012; Bell, Mills, and Fadell, 2013), we used a similar sample population.

First, we examined the list of all schools that offered IS programs as shown in The College Blue Book (2014, pp. 936-940) and found 649 schools listed; these were cross-referenced with the AACSB website, resulting in 228 schools that met the study criteria. Coders were required to review the IS 2010 Curriculum Guidelines for a specific description of the recommendations for an IS program as summarized in Table 1. One author wrote coder training instruction. This included the seven requirements listed as IS 2010.1 through IS 2010.7 as used in the previous studies. A random sample of 10 schools were selected from the first list of AACSB schools for coder training. Additional data collected included: statistics hours required, programming language used (if listed), programming hours required, data analytics minor or concentration availability, cybersecurity course (if required), total degree hours, mention of a project, mention of an internship, and geographic location of the institution.

The three coders each coded 80 schools with a 40-school overlap to code 120 programs. This total is more than half of the population of AACSB accredited IS Programs as studied by Mills et al. (2012) and exceeds the recommendation of Yamane (1967). Coders 1 and 2 coded schools listed 1 through 40. Coders 2 and 3 coded schools 41 through 80. Coders 1 and 3 coded schools 81 through 120. Thirty-one schools no longer had IS programs listed on their webpages. Additionally, several schools' programs had changed in that they no longer met AACSB criteria; that is, they were no longer located in the school of business or its equivalent. After each coder completed their list of schools, any classification conflicts were discussed and resolved by a review of the master course descriptions. This left a total of 89 schools in the final sample.

Table 2 summarizes the steps taken in the reduction of the initial study population to our final research sample.

Data Collection Stage	n	Reason
The College Blue Book (2014, pp. 936–940)	649	Based on previous research
AACSB accreditation	228	Population of interest
Sample selected	120	AACSB accredited, Blue Book, IS program
Final number of coded schools	89	Had an IS program

Table 2. Development of Study Sample Size

The universities were also coded to their geographic census region (United States Census Bureau, 2018). This was accomplished by one of the coders connecting the division to the state in which the university was located according to the U.S. Census Bureau.

The researchers also coded each university based on the number of required strategic and technical classes. The courses classified as technical classes included: Programming, Data and Information Architecture, IT Infrastructure, and Enterprise Architecture. The courses coded as strategic classes included: Foundations of IS, Systems Analysis, IS Project Management, and IS Strategic Management and Architecture. The curriculum was classified as “highly technical” if it contained three or more courses in the technical category and otherwise designated as “low technical.” The curriculum was considered “highly strategic” when three or more courses were identified in the strategic category and otherwise designated as “low strategic.”

Data for this study were collected through an author review of web pages, curriculum guides, and course descriptions. In some cases, the required information was on the page outlining the IS degree, while in other cases, the researcher had to use the detailed curriculum guide course descriptions. We excluded schools that listed IS as a concentration or emphasis. We also excluded schools with curricula offerings that did not meet the requirements of an IS degree as defined by the ACM 2010 guidelines (Topi et al., 2010). Schools that listed IS as the degree and met the ACM 2010 guidelines were included in the study, even when the degree contained as little as nine credit hours of IS courses (Topi et al., 2010).

4. DATA ANALYSIS AND RESULTS

The selection of universities reflects those business schools with an AACSB designation and offering an undergraduate IS major, concentration, or minor. IT programs in other schools (i.e., Engineering) are not included. There were 89 schools evaluated with a mean of 25.1 credit hours required in IS or 25.1 for CS courses as summarized in Table 3. The number of IS related credit hours varied significantly with a low of 9 and a high of 45 credit hours.

Region	Programs	Mean IS/CS Degree Hours	Mean Guidelines Required
Midwest	23	25.7	4.4
Northeast	17	22.2	3.5
South	36	26.6	4.8
West	13	23.8	4.5
Total/Avg.	89	25.1	4.4

Table 3. Credits and Guidelines by Region

4.1 IS Market Demand

The knowledge, skills, and abilities (KSA) that IS students should possess upon graduation include problem-solving and change management knowledge and skills, the ability to contribute to team objectives, awareness of business processes and procedures, an understanding of customer service focus, some project management experience, a great deal of planning and organization experience, perhaps experience in negotiation, and, hopefully, a good dose of decision-making skills. In addition, IS graduates should possess a collection of technical skills that set them apart from other business graduates. This assortment of KSAs that IS graduates should possess should be reflected in the demand for their services in the market. A review of the statistics available to gauge the demand for professionals with IS degrees would indicate that IS programs should be flourishing. The predicted job growth for a sample of IS related occupations indicates better than average growth. The average growth for all occupations from 2016 to 2026 is projected to be around 7% (U.S. Bureau of Labor Statistics, 2018). The list in Table 4 indicates that many occupations for which an IS degree prepares students are far above the average projected growth and that the median pay for IS/IT related occupations greatly exceeds the May 2017 median pay of \$37,690 (U.S. Bureau of Labor Statistics, 2018). A review of popular job search websites using the search term “Information Systems Degree” currently indicates a healthy demand for IS graduates (e.g., Indeed.com, 2019 listed 375,822 jobs).

Occupation	BLS Predicted Growth 2016-2026	2017 Median Yearly Pay
Info Security Analyst	28%	\$95,510
Ops Research Scientist	27%	\$81,390
Software Developer	24%	\$103,560
Web Developers	15%	\$67,990
Management Analyst	14%	\$82,450
IS Manager	12%	\$139,220
Database Administrator	11%	\$87,020
IT Technical Support	11%	\$52,810
Systems Analyst	9%	\$88,270
IT Sales Engineers	7%	\$98,720
Network Administrator	6%	\$81,100
Average	14%	\$88,913

Table 4. IS Related Occupations, Growth, and Median Salary

With strong market demand, much higher than average pay, and potential job growth, IS programs should be growing to

meet the needs of an increasing number of students. However, existing research indicates that the number of IS programs in the United States has declined in the past and recently as well (AACSB, 2012-2019; Burns et al., 2014; Li, Zhang, and Zheng, 2014; Bowman, 2018; Case and Tabatabaei, 2019). Apigian and Gambill (2010) found 240 IS programs in AACSB accredited schools in 2010. Their final sample size was 127. Our study identified 228 IS programs, coded half of them, and obtained a final sample size of 89. Table 5 provides an overview of studies conducted on IS program curricula. The second point to compare is the number of core courses that were required. A decline in IS programs has been consistently observed in research dating back to 2000 and is discussed by Apigian and Gambill (2010) who captured the concerns of other researchers. There could be several reasons for this apparent decline (e.g., the economic downturn following 2007, the increased cost of higher education, etc.) that warrant additional research. However, the question is, why are students staying away from IS/IT related programs?

Study ¹	Year(s) Data Collected	Sample Size Beginning / Final	Filtered for AACSB	Data Source
Maier	1996	108 / 43	Yes	Survey
Gill ²	1999	193 / 193	N.I.	Faculty
Porter	2003	222 / 222	No	Website
Pierson	2005	295 / 295	Yes	Website
Kung	2006	232 / 140	Yes	Website
Pierson	2008	306 / 306	Yes	Website
Lifer	2009	295 / 50	Yes	Website
Apigian	2010	240 / 127	No	Website
BB 41	2018	228 / 89	Yes	Website
Data Guide ³	2012-2019	831/558	Yes	Survey

1. The source for studies in order are Maier and Gambill (1996); Gill and Hu (1998-1999); Porter and Gambill (2003); Pierson and Kruck (2005); Kung, Yang, and Zhang (2006); Pierson, Kruck, and Teer (2008); Lifer, Parsons, and Miller (2009); Apigian and Gambill (2010); The College Blue Book (2014); and AACSB (2012-2019).
2. A survey of 240 faculty members in undergraduate programs representing 193 higher education institutions in the United States. AACSB filter was not indicated (N.I.).
3. Based on the international population of 831 accredited school members and a sample of a controlled set of 558 accredited school members.

Table 5. Existing Research of IS/IT-Related Undergraduate Programs

Regardless of the reasons, IS degree programs are not thriving as one would expect from the market demand for students with the knowledge, skills, and experience garnered from completing a program that focuses on technical skills and provides professional education in managing IS.

Key Finding: The percentage of IS programs at AACSB schools continues to decline while the demand for IS skills continues to increase.

4.2 Are MIS Programs Following 2010 AIS Guidelines?

In evaluating the extent of university compliance with the suggested curriculum guidelines, the first step was to evaluate how many of the AIS Guidelines were covered by a required course by each of the universities. The researchers found that only 3 of the 89 universities required a specific IS or CS course to fulfill all seven guidelines (Figure 1). The distribution indicated that a mean and median of 4.4 and 4.0 categories of the AIS Guidelines were met, respectively. The findings of this study indicate that 23 of the universities required 3 or less of the AIS suggested categories.

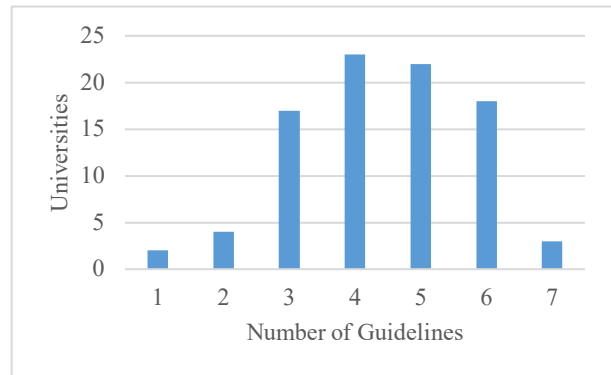


Figure 1. Frequency of Guidelines Covered

Key Finding: Mixed adherence to AIS 2010 Guidelines. Foundations of IS, Data and Information Architecture, and System Analysis were all required by at least 60% of the existing IS programs, but the other core areas are not required.

4.3 Are Certain Subjects Being Emphasized?

To further understand issues of compliance with the recommendations, the researchers next evaluated which of the guidelines were covered by a required course as displayed in Figure 2. Foundations of IS (85%), Data and Information Architecture (91%), and Systems Analysis and Design (88%) were commonly but not universally required. Foundations of IS was recommended to have a significant coverage for every career path in the 2010 guidelines and may be considered a core class that introduces basic IS concepts as well as strategic digital innovation to all students in business schools (Fichman et al., 2014). Data and Information Architecture was often represented by one or more courses dedicated to database studies and represented the guideline that most commonly required a dedicated course, indicating that this category is a technical skill that is not easily covered within other courses and represents skills that are in high demand by employers such as SQL programming (Burns et al., 2018). Systems Analysis and Design was commonly used as the capstone course for programs and required group and project work. While this is not necessarily seen as a required technical skill, it may strengthen the soft skills that are an essential requirement for IS positions (Burns et al., 2018).

IS project management (57%), IT Infrastructure (55%), and IS Strategic Management and Architecture (44%) all had universities that did not specifically require a course that focused on IS or CS. It could be argued that some IS Project Management and Strategic Management requirements may have been addressed through required general management

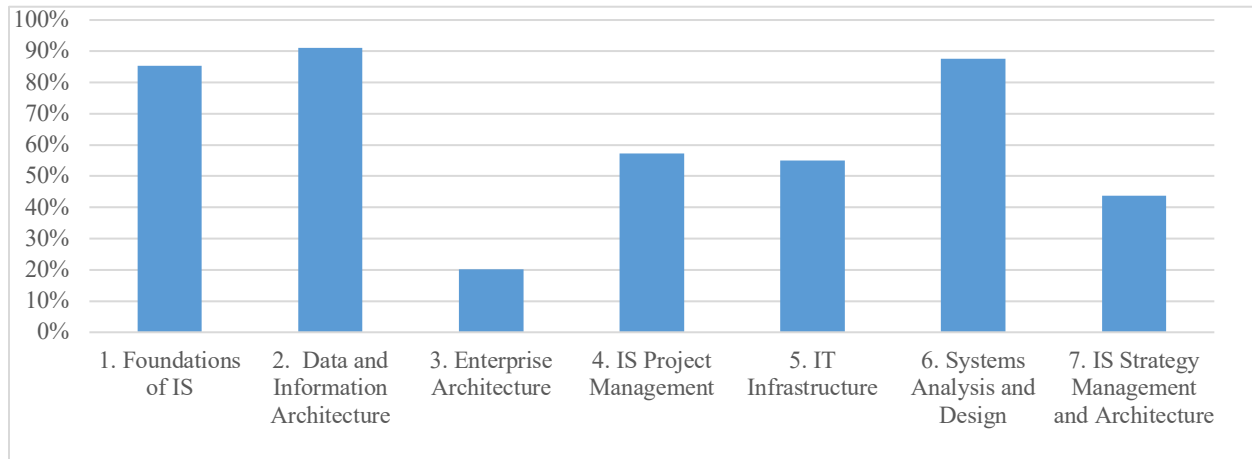


Figure 2. Percent of Universities Requiring a Course by Guideline

courses. This requirement may also be addressed by offering significant project management work in other courses such as a Systems Analysis and Design course (Janicki, Fischetti, and Burns, 2016; Clark et al., 2017). Many entry-level job openings list knowledge of network infrastructure as a requirement, and network certification is the most commonly required certification (Burns et al., 2018), yet only 55% of schools in this study required Infrastructure courses, possibly limiting graduates' opportunities.

Enterprise Architecture (20%) represented a guideline that was not required by 80% of the universities in this study. This low coverage is consistent with other recent studies which found that enterprise architecture courses were not widely available, whether required or as electives (Clark et al., 2017).

The area of compliance by category is shared with the two prior studies on which we based this work, and while our study is not a perfect replication, there are three critical points that overlap. The first is sample size. We used the same methodology to generate a random sample. The previous research, which appears to use the same dataset, found 246 colleges and universities that met their initial criteria and coded half of them. Mills et al. (2012) found that 2.7 of the core guidelines were required while our research found that 4.4 of the core guidelines were required, indicating that requirements are increasing. The final point was examining which of the core courses were required, as studied in Bell, Mills, and Fadell (2013). The differences indicate that IT infrastructure has declined as a requirement, while the converse is true for strategic and project management.

Not all the guidelines required significant coverage for every designed career path (Topi et al., 2010). This indicated that some guidelines may be perceived as adequately covered without a required, dedicated course. Thus, students can use electives if they determine a need for additional education in a core course for their career path.

The programs in this study on average required more than 25 credit hours, suggesting that more than 8 three-credit hour courses were required by the average program. This implies that while each guideline was not required, these programs may also provide the opportunity for the student to complete an additional guideline or to specialize in a chosen career path.

Studies have suggested the requirement to continuously update the field given the rate of change encountered (Maier

and Gambill, 1996; Gill and Hu, 1998-1999; Lee et al., 2002; Kung, Yang, and Zhang., 2006). Department Chairs must determine if this should be done at the Curriculum Chair level or within the courses by faculty. The longitudinal implications are that management functions are increasingly emphasizing technical infrastructure which could affect the emphasis of other technical components of a healthy IS curriculum.

Another significant technical aspect in IS, while not a suggested guideline, is programming, which has been a widely required component. Our study found that programming was a technical skill within IS that was required by 81% of the universities analyzed. Additionally, 34.8% of the universities required multiple courses in programming, which indicated a high value in basic programming skills. This is consistent with other studies that suggest that programming is an essential technical concept that needs to be taught to IS graduates (Burns et al., 2018) and that students' programming success may be improved with gradual and multiple exposures (Reynolds et al., 2017). The prevalence of this technical component and the lack of universal compliance made the researchers question whether technical skills or strategic management was being emphasized in current IS curricula. Table 6 summarizes the percentage of programs adhering to guidelines observed in the Bell, Mills, and Fadell (2013) study, this study, and the percentage difference between the two studies.

Guideline	Percent of Programs		
	Bell et al. (2013)	Current Study	Change
IS Foundations	87	85	-2
Data and Information Architecture	97	91	-6
Enterprise Architecture	17	20	3
IS Project Management	38	57	19
IT Infrastructure	70	55	-15
Systems Analysis and Design	84	88	4
IS Strategic Management	29	44	15

Table 6. Percent of Programs with Guideline Courses

Key Finding: Foundations of IS (85%), Data and Information Architecture (91%), and Systems Analysis and Design (88%) were widely taught while programming, which was viewed as an elective, was also widely required (81%). This suggests that these are the main concepts that required course-specific coverage in the majority of IS curricula. This shows that there has been a decline in the emphasis on IT infrastructure from past studies, while management courses have been increasingly required.

4.4 Is There an Emphasis on Technical Skills or Strategic Management?

Technical skills are required for most IS positions, but many courses are more strategic than technical and, therefore, emphasize critical thinking and communication skills to be able to break down problems in order to act as a bridge between IT and business units. To evaluate whether programs placed an emphasis on strategic skills versus technical skills, we coded the required courses as either technical (Programming, Data and Information Architecture, IT Infrastructure, and Enterprise Architecture) or strategic (Foundations of IS, Systems Analysis, IS Project Management, and IS Strategic Management and Architecture) and scored the programs as high if they required courses in three or more of either of those areas and low if they required two or fewer. The results suggested that the base requirements were evenly distributed, with 38 of 89 universities having a lower number of core requirements in more specifically defined technology courses and 37 of 89 universities placing a lower required emphasis on strategy as a requirement dedicated to their core IS classes (Table 7). These universities may fill these requirements through additional requirements in their degree, electives, or degree concentrations, but they are not required as part of the core IS curriculum. That neither strategy nor technology is emphasized may suggest that the curricula are allowing students to work toward specific concentrations that meet career goals. To this end, we also wanted to evaluate any geographic area for emphasis on strategic or technical skills.

Universities		
High Strategy	16	36
Low Strategy	22	15
	Low Technology	High Technology

Table 7. An Emphasis on Strategy or Technology

Key Finding: Technical skills and strategic management seem to be equally emphasized in current IS curricula.

4.5 Does the Curriculum Emphasis Differ by Geographic Area?

The guidelines designed in 2010 were meant to provide flexibility for local needs (Topi et al., 2010), and it is important to receive feedback from the companies recruiting students in your local area (Noll and Wilkins, 2002). However, the core guidelines were meant to help IS programs to not focus solely on local employment needs. By grouping the universities by their U.S. Census districts, we looked for differences in curriculum philosophies that may have been driven by the needs of local employers. The research indicated that the South emphasized high strategy with 78% requiring most of the strategic components (Table 8) and the West emphasized

technology with 85% emphasizing technology components (Table 9). Further, the North East seemed to emphasize flexibility with 46% of the schools requiring neither a majority of strategic nor technology components (Table 10). The Midwest was more diverse with no clear emphasis in the region (Table 11). This seems to suggest that IS curricula may be susceptible to local biases, and universities may wish to take measures to guard against limiting their graduate’s mobility in an increasingly global workforce (Gorgone et al., 2006; Topi et al., 2010).

Universities		
High Strategy	11	17
Low Strategy	6	2
	Low Technology	High Technology

Table 8. Southern: Strategy/Technology Emphasis

Universities		
High Strategy	0	5
Low Strategy	2	6
	Low Technology	High Technology

Table 9. Western: Strategy/Technology Emphasis

Universities		
High Strategy	2	4
Low Strategy	8	3
	Low Technology	High Technology

Table 10. Northeastern: Strategy/Technology Emphasis

Universities		
High Strategy	3	10
Low Strategy	6	4
	Low Technology	High Technology

Table 11. Midwestern: Strategy/Technology Emphasis

Key Finding: Requirements seem to be influenced by a local bias.

4.6 Is There an Emphasis on Practical Experience?

We also evaluated whether the curricula required practical experience in the form of an internship or corporate-led project. The findings indicate that 22.5% of all programs had a requirement of an internship or a corporate-led project as summarized in Table 12.

Region	Programs	Programs Requiring Practical Experience
Midwest	23	26.1%
Northeast	17	23.5%
South	36	22.2%
West	13	15.4%
Total/Avg.	89	22.5%

Table 12. Percentage of Programs Requiring Practical Experience

4.7 Is There an Emphasis on Security?

An interesting finding was the general lack of an introductory course in cybersecurity. Just as IS is often the bridge between business and technology, the person with the IS degree would naturally be involved in ensuring that the organization has processes in place to ensure IS security. Only 6.7% of all programs required an IS security course (Table 13). Yang and Wen (2017) found this to be 5.2% of AACSB as of Spring 2016. This is consistent with the findings of other researchers (Hwang, Ma, and Wang, 2015). However, research indicates that IS security knowledge is a critical industry need (Morgan, 2017; Yang and Wen, 2017; Perhach, 2018; Avery and Oakley, 2019). While some programs in the South and West required a specific security course, there were none in the Midwest or Northeast. Given the frequency and danger of disruptions to organizations' IS, this seems at best unfortunate and at worst a complete failure on our part as IS academics and professionals. While an introductory course would not qualify the person with the IS degree to oversee cybersecurity, it should at least ensure the person had adequate knowledge to inform the leaders in the organization of the nature of the threats and suggest efforts to secure the systems. The need for a course may also be weighed against the fact that it is not a specific requirement for many entry-level positions (Burns et al., 2018).

Region	Programs	Programs Requiring Security
Midwest	23	0.0%
Northeast	17	0.0%
South	36	11.1%
West	13	15.4%
Total	89	6.7%

Table 13. Percentage of Programs Requiring a Security Course

4.8 Is There an Emphasis on Data Analytics?

Finally, the researchers wanted to evaluate whether the programs had a data analytics related concentration, major, minor, or certification within the business school and the program's statistics requirements. In the 2017 and 2018 executive summary, AACSB started listing Data Analytics as a potential requirement for Bachelor's degrees offered for the first time and found that nearly 2% of respondents listed that an analytics degree was available compared to nearly 40% having an IS degree. The same survey determined that 17% had a Master's level data analytics, quantitative methods, or statistics degree compared to 25% with an IS-specific Master's degree. AACSB has been placing an increasing emphasis on data analytics in its accreditation process. Big data and data analytics often heavily rely on statistics and IS-related courses. To this end, we examined both the level of statistics required and if the schools with IS programs also provided majors, minors, concentrations, or certificates within the business school and the program's statistics requirements.

In this study, statistics was required by 92% of all the programs with a mean of 1.5 statistics courses per program either in their core or as part of the department requirements (Table 14). Data analytics degrees, certificates, or minors were available in 39.3% of the programs (Table 14). Data Analytics certifications may overlap with courses such as database and programming, with these skills being key components for analytics certifications (Tittel and Lindros, 2018). Adding

analytics certifications and degrees follows a "best practices" in increasing enrollment in underutilized courses (Koch et al., 2010).

Region	Programs	Programs Requiring Statistics	Mean Statistics Classes	Data Analytics Program
Midwest	23	100.0%	1.6	47.8%
Northeast	17	88.2%	1.5	52.9%
South	36	88.9%	1.4	36.1%
West	13	92.3%	1.5	15.4%
Totals	89	92.0%	1.5	39.3%

Table 14. Percentage of Curricula with a Data Analytics Program

Key Finding: Data Analytics degrees, minors, or certificates were available in over 39% of the programs, and statistics/analytics courses were required in 92% of the programs.

The review of IS Curricula trends consisted of asking eight research questions. Through an examination of AACSB accredited IS programs, the researchers found the answers to those questions, summarized in Table 15. These results can be used to engender an honest discussion on the future development of IS programs and clarify where to focus efforts to cater to various stakeholders. The next section concludes this paper with a thorough review of the findings and possible avenues of additional research.

Research Question	Key Finding Summary
1. Market demand:	The percentage of IS programs at AACSB schools continues to decline while the demand for IS skills continues to increase.
2. 2010 AIS Guidelines adherence:	In general, very low among the study sample.
3. IT/IS subject emphasis:	Intro to IS, Database, SAD, and Programming.
4. Technical or strategic:	Technical skills and strategic management education equally emphasized.
5. Geographic differences:	Yes, by region.
6. Practical experience emphasis:	Low, only 22.5% of schools have any requirement.
7. IS security emphasis:	No, there is insufficient emphasis on IS security issues.
8. Data Analytics emphasis:	An increasing emphasis, potentially improving faculty utilization with common IS courses.

Table 15. Research Questions & Key Findings Summary

5. CONCLUSIONS AND RECOMMENDATIONS

IS programs and curricula exist in a turbulent environment with a declining number of IS programs by percentage of AACSB accredited business schools and a declining number of student



enrollments (Koch et al., 2010; Stefanidis and Fitzgerald, 2010; AACSB, 2012-2019; Burns et al., 2014; Li, Zhang, and Zheng, 2014; Bowman, 2018). The recommended program guidelines are insufficient to meet current challenges. To meet industry requirements, and the challenges of low student enrollment, the community needs to produce students capable of critical thinking, technology skills, and soft skills to bring value to their organization.

AIS guidelines are not being strictly followed by the majority of AACSB IS programs. This seems to be consistent with suggested best practices to attract students by providing flexibility that is vital for a student's ability to pursue career objectives. There appears to be movement away from IT infrastructure as a focus, and this may reflect programs responding to industry needs as infrastructure is moving toward the cloud. Project management and strategy appear to be courses that are increasingly required. Although strategic and project management would be much helped by practical experience, few programs require this component. Practical experience components may be challenging as a requirement due to the difficulties of managing the nature of the experience. However, practical experience may prove valuable in developing critical thinking and soft skills. Some type of practical experience is a requirement even for entry-level IS positions (Burns et al., 2018). Faculty should aggressively pursue these opportunities for their students and add internship requirements if at all feasible.

Database and programming are courses that are required by most IS programs. This appears to be in line with the demands of industry where these skills are in high demand among entry-level IS positions. Faculty developing an IS curriculum must continue to adjust to industry needs, but they must also take care not to limit their students to local demand. Programs that are forced to limit offerings that meet the suggested guidelines should consider if the suggested guidelines are adequately addressed somewhere within the curriculum. If a guideline such as IT infrastructure is eliminated as a required course, the essentials could still be addressed within the curriculum by mapping out the essentials and covering them in the framework of other courses.

Security, while not listed in the AIS guidelines, is also an important aspect of IS that does not appear to be covered by specific coursework. This lack of specific coursework seems to contradict industry demands since security has become a major issue. However, it may be consistent with how industry views the topic. Most jobs do not specifically discuss security as a job requirement (Burns et al., 2018). This may be an issue that needs to be handled throughout the program and addressed separately in each course. It may also be an area of opportunity for IS programs since it is one of the most common issues faced within organizations. The security issue could also be addressed by providing security as a school-wide course for students entering the business school. Early exposure to information security issues can add awareness about an important topic and provide an opportunity to recruit students to IS.

Many schools are adding programs that allow organizations to harvest additional value from IS courses in the form of adding business analytics programs. Business analytics has concepts that are shared by IS in the form of databases, programming, and statistics. Additionally, the inclusion of relevant certification paths in selected IS courses may be able

to increase enrollment by increasing the perceived "return on investment" for those courses for students. Best practices suggest increasing flexibility in curricula and increasing value to other departments (Koch et al., 2010). Analytical skills are essential to many career paths. IS programs need to continue to look for and promote their courses as having synergy with other departments and degrees. For example, if there is a universal need for analytical skills and critical thinking, then learning how to program could be promoted to develop a student's skills as they develop analytical algorithms using programming tools. Also, selected programming languages can add value to other academic programs in the university where expertise is required in quantitative algorithms.

Recommendations for IS Faculty:

1. Develop opportunities for real-world, practical, and relevant experience before graduation.
2. Make a case for the value of IS courses to other majors and concentrations.
3. Develop an entry level "Introduction to Programming" course that is acceptable as a General Requirement course to expose students to the IS career field.
4. Develop an entry level "Introduction to Information Security" course that has value as a core requirement.

5.1 Limitations

There are limitations in this research that should be considered. This study was intended to be a replication of previous work for comparison; thus, it was limited to the status of AACSB schools and did not cover all IS programs that include non-AACSB schools. In addition, we took precautions to ensure that the data on program contents would be reflected correctly at the time of the study. Since we collected data during a limited period of the primary academic year (May 2018 to July 2018), we believe the program requirements would have been relatively constant for this period-of-time. However, a limitation of this study and of most studies, is that changes can occur after the primary period of data collection and the results are valid only as of the time of the study. Moreover, a possible limitation to this study might be the use of the AIS 2010 MIS guidelines, which may have led to a lower compliance with existing IS curricula. However, the use of the AIS 2010 MIS guidelines was necessary because the 2010 MIS guidelines were widely recognized and could best ensure a consistent comparison with previous studies.

5.2 Additional Research

Many topics explored in this study are suitable for further research. Future research is required to address the health and value of IS programs, not only for AACSB schools, but also for non-AACSB schools, both in the United States and internationally, emphasizing a call for additional research on this topic as implied by Stefanidis and Fitzgerald (2010). Conducting a survey of business school deans requesting current information about IS curricula in the U.S would also be an interesting follow-on area of research. The IS educational community needs to do a better job of both aligning curricula to emerging career realities and marketing to potential students.

Specific topics are listed below:

- Where have all the IS students gone?
- What are the factors affecting IS student enrollment?
- Is this decline matched in other disciplines?
- What is happening to the higher education business model?
- Is there a better way to provide relevant IS career preparation using the current model and resource limitations?
- Does a student need a college degree to have a successful career in IS?
- Should a survey of IS Chairs be conducted concerning curricula considerations, student feedback on the program, and trends in student population growth and decline?
- Is the IS community adequately marketing the opportunity to potential students?
- Are we effectively matching our curricula to career preparation in emerging career opportunities?
- Are we promoting the value of IS courses to other disciplines (common requirements)?
- Are we evaluating core courses to see if they are required in other departments (e.g., programming and database courses)?
- Can we provide more than just “Intro to IS” to other business school students (e.g., data analytics programs usually require database courses, and many disciplines would benefit from an introduction to programming course where problem-solving is emphasized)?

The next decade may be challenging for the IS community, not because of a lack of value for IS education, but because of changing dynamics of higher education, changing market needs, and the impact of IT on traditional IS careers. This study and subsequent research may help the IS community focus on factors that will significantly improve and communicate the value of an IS program of study.

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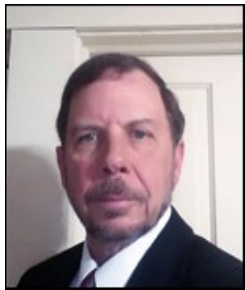
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