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The Master's Program in Information Systems: A Survey of Core Curricula in AACSB-Accredited Business Schools in the United States

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ABSTRACT

This paper investigates the core curricula of Information Systems (IS) master's programs. It examines all 532 AACSB-accredited business schools in the United States and identifies 74 IS master's programs. MSIS 2016 and other curricular models and studies are used in a research framework to survey core courses. The top three required courses are Data, Information, and Content Management, Systems Development and Deployment, and Project and Change Management. One unexpected result is that Business Intelligence/Analytics/Data Mining is now the fourth most popular core course, while Business Continuity and Information Assurance is the fifth. The results are compared to those of a 2012 study to examine IS master curricula' change over the last decade. Based on actual data on core courses being offered, a new IS master's curriculum model is developed.

Keywords: AACSB, Curriculum design & development, Graduate education, IS curriculum, IS education, IS programs

1. INTRODUCTION

The unemployment rate for IT occupations in the US hit a near-record low of 1.3% in March 2022, with two-thirds of the new hiring coming from IT services and custom software development occupations category (CompTIA, 2022). This strong growth is consistent with employment in the larger economy, which has rebounded strongly. In the US, the unemployment rate dropped to 3.6% in March 2022 as reported by the US Bureau of Labor Statistics (BLS) (BLS, 2022). Indeed, IT employment continues to have a growth outlook. According to the latest BLS forecast, the Computer and Information Technology group has the seventh-highest 2020-2030 growth rate of 13% out of 24 (non-military) occupation groups (BLS, 2021).

With their employment outlook often tied to the larger economy, IS practitioners need to have backgrounds and skillsets that match demands. A 2015 BLS publication showed that the wage premiums of a master's degree over a bachelor's degree ranged from 18% to 26% for a selection of IT occupations (BLS, 2015). An IS master's degree can impart more advanced knowledge and skills and enable IS professionals to be more competitive in the job market. The present study investigates IS master's programs because the IS field is dynamic, and a master's degree represents a significant professional and educational milestone for many IS professionals.

As the IS field continually evolves, discussions about its core curriculum are also ongoing. The core curriculum of IS master's program is important for two reasons: internal and external. Internal to a degree program, the number of courses students can take is limited, so institutions require core courses

they consider fundamental to provide the knowledge for the practitioners of a discipline to possess. Externally, IS master's programs operate in a competitive environment; these programs "need to adopt new courses in response to anticipated market needs" (Elazhary & Morelli, 2016, p. 526), and core courses can reflect market needs and demands for knowledge and skillsets.

Therefore, IS master programs' core curricula, in aggregate, effectively represent these programs' view on important topics and the core body of knowledge that meets demands of the profession and the market. As such, this study aims to meet three goals. The first goal is to survey the core courses of IS master's programs to assess the topics and content the community deems essential. The second goal is to develop a new descriptive IS master's curriculum model representing an inclusive and aggregate view of these programs. The third goal is to assess the evolution in the core curriculum of IS master's programs over the last decade. This third goal is valuable because by comparing the extent of the adoption of core courses over time, one can observe the current state and explore the direction of the core curriculum. Additionally, a descriptive study of the field over time can help provide perspective to the IS field's identity (Lim et al., 2007). To survey the programs' core courses, MSIS 2016, other curricular models and prior studies are used in a conceptual framework to direct the collection and analysis of data.

As the process of reviewing IS curricula is ongoing and continuous (Leonard et al., 2019), there is now a need for an up-to-date examination of IS master's programs. The results of this study should benefit both business schools and organizations alike. At the master's level, business schools and their curriculum developers can understand the offerings of their peer institutions, and hiring organizations can ascertain the

learning requirements placed on students by the IS academic community.

2. LITERATURE REVIEW AND MOTIVATION FOR STUDY

While much research exists on the IS curriculum at the undergraduate level, there is limited research on the graduate IS curriculum (Shah et al., 2018). Prior research reviewed the literature on IS master's curricula up to 2012 (Yang, 2012). This literature review thus focuses on those works published since 2012. Since 2012, the literature on IS master's curriculum has remained sparse and has taken either the survey or case study approach. Focusing on research that used *surveys*, Yang (2012) reviewed 273 university websites and found 99 institutions offering IS master's programs. That study developed an IS master's curriculum model based on the most widely-required core courses, the top five of which were analysis/modeling/design, IT infrastructure, project and change management, management of IS, and implications of digitalization. Apigian and Gambill (2014) reviewed 329 university websites and identified 81 IS master's programs. The top five required courses identified in their study were database, management of IS, systems analysis and design, project management, and data communications and networking. Apigian and Gambill (2014) also found that (then current) MSIS 2006 "is not followed closely by universities reviewed in this research" (p. 47).

Examining the digital transformation readiness of different IS master's programs, Elazhary and Morelli (2016) surveyed 161 universities in the Academic Ranking of World Universities (ARWU) 2015's top 10 countries represented. The authors examined up to five IS master's programs in each country in the order of their institutions' ARWU rankings. They then reviewed those programs' core and elective offerings to see if those courses pertained to digital transformation readiness, such as big data, cloud computing, strategic IT management, and digital business. Of the 29 IS master's programs assessed, they found that Switzerland and the US rated relatively high in offering both technology and management-oriented courses. In contrast, the UK, Canada, Australia, Denmark, and Sweden rated relatively high in offering technology-oriented courses but relatively low in offering management-oriented courses.

Focusing on *case study*-based research, Topi et al. (2014) described the characteristics and emphases of three IS master's programs in Australia, Ireland, and the US; they observed the increasing integration of IT and business and the necessity for IT professionals to be both technology and business professionals. Ramesh and Gerth (2015) documented the design and implementation by IS faculty of an integrated core curriculum in its Master of Science in Information Systems (MSIS) program. Program innovations that were identified included "sequencing of content," "flexible use of faculty strengths," "integrated thinking outside of silos," and students' "professional development integrated with coursework" (p. 307).

Another study described an MSIS program development effort that utilized an iterative process consisting of three phases: identify outcomes, develop assessment, and design learning activities (Shah et al., 2018). Tan et al. (2018) documented their experience in delivering a business analysis

course (required by two master's degrees at a UK institution) with its course content aligned with a professional certification. They observed a positive outcome from three stakeholders (students, academics, and industry), called for better alignment of IS graduate programs with standard work practice, and advocated enabling students to earn a professional certification before graduation.

This literature review suggests a dearth of research in IS graduate programs in the last decade. In particular, there were few examples of survey-based studies of master's curricula in a large population. Babb et al. (2021) suggested an open-community approach for evolving the IS curriculum. Still, the scarcity of survey and case study research on IS graduate programs highlights the need for the present study. In addition, it has been several years since the publication of MSIS 2016—the latest graduate IS degree program recommendation (Topi et al., 2017). MSIS 2016 is "a snapshot" and needs "to be tested in practice" (Topi, 2017, p. 27). This need is germane because IS is a dynamic field and essential concepts need to be regularly reviewed (Helfert, 2011; Hwang et al., 2015). Therefore, it is important to periodically assess the institutions' curricula and disseminate the research results in a timely manner (Vijayaraman & Ramakrishna, 2001). Answering that call, the present study surveys IS master's programs in AACSB-accredited business schools and examines their core curricula. Based on this survey of actual core curricula and courses, this study then develops a new, descriptive model of the IS master's curriculum. Utilizing the obtained results, the present study also examines the evolution of actual IS master's core curricula in the 2010s.

3. RESEARCH FRAMEWORK

Curriculum recommendations for professional master's programs in IS started to appear in the early 1970s (Ashenurst, 1972), followed by Nunamaker et al. (1982). Over 17 years later, MSIS 2000 (Gorgone et al., 2000) updated the IS master's curriculum recommendation, which corresponds with the rapid growth in the Internet and distributed-computing age. This probably marks the beginnings of a modern IS master's program. MSIS 2000 was followed by MSIS 2006 (Gorgone et al., 2006) and MSIS 2016 (Topi et al., 2017). The latest MSIS 2016 recommendation "specifies competency areas as the highest-level categorization of competencies" (Topi et al., 2017, p. 8) suggesting nine IS competency areas that graduates of an IS master's program should possess (see Table 1). MSIS 2016 fully recognizes that it "will be applied in a variety of different ways determined by its users" (Topi, 2017, p. 27). In the present study, IS courses are based on MSIS 2016's competency areas.

While MSIS 2016 constitutes the main framework of this study, IS master's programs at large may require courses that do not correspond to MSIS 2016, as IS programs have been found not to follow curricula outlined by curriculum guidelines (Apigian & Gambill, 2014; Vijayaraman & Ramakrishna, 2001). To capture courses that do not correspond to MSIS 2016's competency areas, this study also utilizes courses previously used and defined by prior recommendations and studies, including the MSIS 2006 model curriculum (Gorgone et al., 2006). For example, an institution may still require courses based on MSIS 2006, which was published before the

latest MSIS 2016. Specifically, the following MSIS 2006 courses (which differ from those in MSIS 2016) are included:

- Capstone (Gorgone et al., 2006)
- Emerging Technologies and Issues (Gorgone et al., 2006)
- Project and Change Management (Gorgone et al., 2006)

Competency Areas
Business Continuity and Information Assurance
Data, Information, and Content Management
Enterprise Architecture
Ethics, Impacts and Sustainability
Innovation, Organizational Change, and Entrepreneurship
IS Management and Operations
IS Strategy and Governance
IT Infrastructure
Systems Development and Deployment

Table 1. MSIS 2016 Competency Areas (Topi et al., 2017)

Building on prior research, the present study also employs courses established by previously published studies to map core courses. The present study uses similar courses from previous studies to maintain analytical consistency and facilitate comparison over time. Additionally, a master’s program may require specialized courses that are not called out by the broad competency areas of MSIS 2016. For example, a project or a thesis may be part of an institution’s master’s program, so a Project/Thesis course is included. Thus, the following courses are used to accommodate the core requirements of some institutions:

- Application Development (Topi et al., 2010a)
- Business Intelligence/Analytics/Data Mining (Yang, 2012)
- Business Process Management (Topi et al., 2010a)
- Enterprise Systems (Topi et al., 2010a)

The conceptual foundations of all courses used by this study are summarized in Table 2.

4. METHOD

This study employs an established methodology (Stefanidis & Fitzgerald, 2014) that has been utilized by prior research to examine business school curricula. Instead of statistical sampling, this paper’s study population strives for a comprehensive view and includes all IS master’s programs in AACSB-accredited business schools in the US. The following sections describe both the scope of the study and the procedures employed.

4.1 Population and Scope of Study

The population of this study consists of the IS master’s programs in AACSB-accredited business schools in the US. This study focuses on IS programs, but IS programs often have different names and place varying emphases on different content areas. To improve internal validity, the following criteria are applied to admit IS master’s programs into the study population: First, this study examines IS master’s programs that are accredited by The Association to Advance Collegiate

Schools of Business (AACSB). This is because MSIS 2016—the curricular guidelines upon which the research framework is built—states that business is traditionally the most common domain of practice for MSIS degrees (e.g., Topi et al., 2017, p. 3). Therefore, utilizing these schools enables this research to examine samples that are internally consistent (i.e., AACSB-accredited) and business-oriented (i.e., business schools). Moreover, examining IS master’s programs in business schools is appropriate because AACSB explicitly recognizes “information systems” as a business discipline (AACSB, 2021).

Course Categories	Conceptual Foundations
Application Development (including Programming)	Topi et al., 2010a
Business Continuity & Information Assurance	MSIS 2016
Business Intelligence/Analytics/Data Mining	Yang, 2012
Business Process Management	Topi et al., 2010a
Capstone	MSIS 2006
Data, Information, & Content Management	MSIS 2016
Emerging Technologies & Issues	MSIS 2006
Enterprise Architecture	MSIS 2016
Enterprise Systems	Topi et al., 2010a
Ethics, Impacts, & Sustainability	MSIS 2016
Innovation, Organizational Change, & Entrepreneurship	MSIS 2016
IS Management & Operations	MSIS 2016
IS Strategy & Governance	MSIS 2016
IT Infrastructure (incl. Networking)	MSIS 2016
Project/Thesis	Yang, 2012
Project & Change Management	MSIS 2006
Role of IS in Organizations/Fundamentals of IS	MSIS 2016; MSIS 2006
Systems Development & Deployment	MSIS 2016

Table 2. Course Categories and Their Conceptual Foundations

Second, this study treats information systems (IS) as separate from information technology (IT). Specifically, master’s programs in IT are not included in this study because IT and IS are distinct and separate disciplines per the Association for Computing Machinery (ACM) Curricula Recommendations (ACM, 2020) and The Joint Task Force for Computing Curricula (2005). In fact, The Joint Task Force for Computing Curricula (2005) states that “Information Systems focuses on the information aspects of information technology. Information Technology is the complement of that perspective: its emphasis is on the technology itself more than on the information it conveys” (p. 14). This distinction between IS and IT was made again in the latest version of the Computing Curricula 2020 (ACM & IEEE-CS, 2020). The ABET Computing Accreditation Commission (2019) also has separate sets of program criteria for IS and IT. Thus, this study includes only those IS master’s programs that award degrees with IS in their degree names, including IS, MIS, and CIS.

Third, this study seeks to investigate core courses—those courses seen as crucial to master’s programs in IS, not other

disciplines. Thus, for consistency, this study focuses on standalone IS programs and does not include degree programs that combine two different disciplines, such as

- MS in IS and Analytics
- MS in IS and Security Management
- MS in IS and IT
- MS in IS and Operations Management
- MS in Computer Science and IS

Fourth, master's programs in a related area of IS are not included. For example, if a degree name contains IS but is in a different area or with a narrower aim (e.g., accounting information systems), then that program is not included. Finally, specialized master's programs in other areas of computing, even if they reside in business schools, are not included. For example, a master's program in data science or cybersecurity is not included.

4.2 Data Collection Procedures

This study uses a direct-survey method (Stefanidis & Fitzgerald, 2014) to survey IS master's programs' core courses. Courses based on MSIS 2016 competency areas and previous curricular models and studies constitute the research framework, which guides data collection and analysis of core courses. Because an institution's courses may not exactly match the courses shown in the research framework, an institution's courses are mapped into "course categories" (see Table 2). This mapping approach has been utilized to investigate master's programs in IS (Apigian & Gambill, 2014; Maier & Gambill, 1997; Yang, 2012) and bachelor's programs in IS (Hwang et al., 2015; Kung et al., 2006; Leonard et al., 2019; Lifer et al., 2009; Osatuyi & Garza, 2014; Porter & Gambill, 2004; Yang, 2016). Collected data on courses are mapped into course categories (Apigian & Gambill, 2014; Williams & Pomykalski, 2006), and "where appropriate, the survey groups separate courses in one category if they logically belong to the same course area" (Yang, 2012, p. 209). For example, suppose a program requires a first course in systems design and a second, separate course in systems analysis. In that case, both courses are grouped into "Systems Development and Deployment" as shown in Table 2.

The following procedures are used to collect data on courses. First, IS master's programs often require entering students to have already taken several foundational or bridge courses. Because this study focuses on institutions' IS core requirements, foundational or preparatory courses are not included; only data on the institutions' required IS core courses are collected.

Second, a program may require a "capstone" (Gorgone et al., 2006, p. 171; Topi et al., 2017, p. 36). A capstone, if required by the master's program, typically comprises an integrative experience to be taken by students toward the end of the program. The capstone may involve a project, a seminar course, or some other experience. A course or requirement that is explicitly identified by the program as a capstone or culminating experience is categorized as a capstone (Gorgone et al., 2006). On the other hand, if an institution requires a project/thesis course but does not identify it as a capstone, then that course is mapped as a project/thesis.

Third, an IS master's program may require students to choose core courses from a list of approved courses. This is in contrast to a program that requires a fixed list of core courses,

all of which must be taken by students. Choosing core courses from a list of approved courses is effectively a hybrid between two types of curricular requirements by institutions: requiring students to take all courses from a list of core courses, or letting students choose courses from a more extensive set of courses (e.g., electives) offered by the department or even outside of the department.

To collect data in these situations, this study focuses on examining the core of IS master's programs and assessing the topics that these programs deem essential. When a program requires students to choose core courses from a list of approved courses, this study can include all courses on the list of approved courses, or exclude all courses from the list of approved courses. A program puts courses on its approved list because it treats them as important to the field. But many programs have long lists of approved courses from which to choose, and recording all courses on such a list may not be feasible from a data-capture standpoint. On the other hand, we do not want to indiscriminately discard information by not including any information from the approved list because this study seeks to collect data on the topics that IS master's programs regard as important for the degree. Therefore, the following procedure is used to capture information about courses when a program requires students to choose core courses from a list of approved courses: If a student must select at least half (50%) of the courses on the list of approved courses, then this study considers all the courses on the approved list as required by the program. If not, then the courses on the list are treated as not required. This method represents a balance between including all and excluding all courses on the approved list, while still capturing information about the topics that programs deem important—a goal of this study.

Lastly, a master's program sometimes allows students to choose either a project/thesis option or a non-project/non-thesis option. Typically, a non-project/non-thesis option requires more courses to compensate for the lack of a project/thesis. Because a goal of this study is to capture information about courses that institutions deem essential, this study focuses on a program's non-project/non-thesis option and records its (higher number of) core courses.

5. RESULTS

Data on IS master's programs and their required courses were collected during September and October of 2020. In September 2020, there were 532 schools with business accreditation in 50 states of the US (AACSB, 2020). Of these AACSB-accredited business schools, this study identified 74 master's programs in IS. Table 3 shows the main findings. For each course supported by the framework's conceptual foundations, Table 3 depicts the number (n) and percentage (%) of programs requiring that course as a core (only those courses required by 15% or more of the IS master's programs are shown). The average number of core courses required by the master's programs is 6.7 (or seven rounded).

Table 3 shows that the most popular course is Data, information, and Content Management, which is required by the highest percentage (82%) of programs surveyed. The Systems Development and Deployment course has the next highest adoption percentage of 61%—a large gap of difference of 21% (= 82% – 61%) below that of the top course. Starting with Systems Development and Deployment, the subsequent

six courses are required by 61% to 35% of programs, with succeeding courses' percentages separated from each other by smaller gaps of 2% to 10%:

- Systems Development and Deployment (61%)
- Project and Change Management (59%)
- Business Intelligence/Analytics/Data Mining (54%)
- Business Continuity and Information Assurance (47%)
- IT Infrastructure (45%)
- IS Management and Operations (35%)

Course Category	<i>n</i>	%
Data, Information, & Content Management	61	82%
Systems Development & Deployment	45	61%
Project & Change Management	44	59%
Business Intelligence/Analytics/Data Mining	40	54%
Business Continuity & Information Assurance	35	47%
IT Infrastructure (incl. Networking)	33	45%
IS Management & Operations	26	35%
Application Development (incl. Programming)	24	32%
Capstone	23	31%
IS Strategy & Governance	22	30%
Enterprise Systems	18	24%
Role of IS in Organizations (Fundamentals of IS)	12	16%
Business Process Management	11	15%
Project/Thesis	11	15%

Table 3. Core Requirements of IS Master's Programs

To examine the evolution of IS master's programs over the last decade, Table 4 shows the changes in adoption percentages between the present study and Yang (2012), which serves as the baseline of assessment because of their similar methodologies for consistent comparisons. With this view, the present study provides more of a longitudinal view and extends the 2012 results, which function as "...a baseline of the state of IS master's programs from which future comparisons can be made" (Yang, 2012, p. 212).

As shown in Table 4, eight courses have consistent definitions with results that are comparable between 2012 and the present. Of these eight, the adoption percentages for two courses increased: Business Intelligence/Analytics/Data Mining (10% vs. 54%) and Application Development (18% vs. 32%). Three remained approximately the same: Project and Change Management (60% vs. 59%), Capstone (32% vs. 31%), and IS Strategy and Governance (29% vs. 30%). Three decreased: IT Infrastructure (73% vs. 45%), IS Management and Operations (51% vs. 35%), and Project/Thesis (21% vs. 15%).

6. DISCUSSION

Investigating a degree's actual core curricula as required by business schools reveals a bottom-up view of the topics these schools deem essential, and the obtained empirical results shed light on the current state of these master's programs. This section discusses those insights from developing a new curriculum model based on actual data, assessing changes in IS master's programs since the early 2010s, and considering the

implications of this work. The Discussion section closes by identifying the limitations of this study and some directions for future research.

Course Category	Yang, 2012	Current
Data, Information, & Content Management	-- ^a	82%
Systems Development & Deployment	-- ^a	61%
Project & Change Management	60%	59%
Business Intelligence/Analytics/Data Mining	10%	54%
Business Continuity & Information Assurance	-- ^b	47%
IT Infrastructure (incl. Networking)	73%	45%
IS Management & Operations	51%	35%
Application Development (incl. Programming)	18%	32%
Capstone	32%	31%
IS Strategy & Governance	29% ^c	30%
Enterprise Systems	-- ^b	24%
Role of IS in Organizations (Fundamentals of IS)	-- ^b	16%
Business Process Management	-- ^b	15%
Project/Thesis	21%	15%

^aMSIS 2006 used the course name "Analysis/Modeling/Design" which combined systems analysis/design and data management into one course.

^bNo data reported.

^cMIS 2006 used the course name "Strategy & Policy."

Table 4. Comparison Between Current and Yang (2012) Results

6.1 A New, Empirically-Based Curriculum Model

Whereas top-down curriculum models in IS education (e.g., MSIS 2016) are essential and convey a normative perspective, it is also important to obtain a bottom-up, market-based, and empirical perspective incorporating the collective view of many institutions. The resulting empirical model can then inform the development of the next release of the top-down curriculum. Building on data collected on actual core courses required by the programs, this study develops a new descriptive curriculum model for IS master's programs. The average number of courses required by the master's programs surveyed is 6.7 (i.e., seven when rounded up). Using a 30-credit/10-course curriculum, the new curriculum model contains seven core courses that are the top seven courses required by IS master's programs. The three remaining courses may be elective courses, which allow students to pursue their chosen interests. In order of popularity, the seven core courses are as follows (see Figure 1):

- Data, Information, and Content Management
- Systems Development and Deployment
- Project and Change Management
- Business Intelligence/Analytics/Data Mining
- Business Continuity and Information Assurance
- IT Infrastructure
- IS Management and Operations

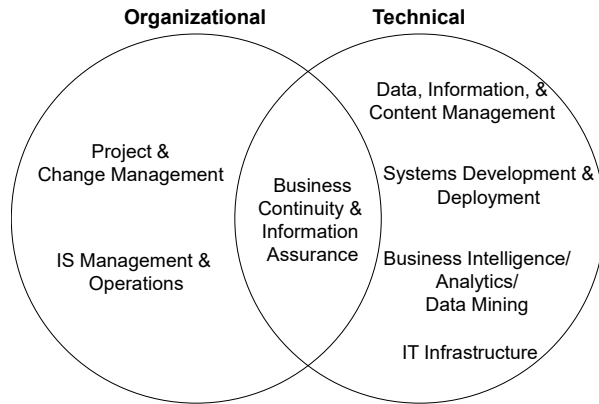


Figure 1. Curriculum Model of IS Master’s Program: Core Courses

In Figure 1, management- and organization-oriented courses include Project and Change Management (Gorgone et al., 2006) and IS Management and Operations. The Project and Change Management course explores “Managing projects within an organizational context, including the processes related to initiating, planning, executing, controlling, reporting, and closing a project” (Gorgone et al., 2006, p. 166). IS Management and Operations “covers the capability to develop, maintain, and consistently improve domain performance while providing appropriate information systems, services, and infrastructure” (Topi et al., 2017, p. 18) and involves the application of “professional management skills to the design and management of an effective IS organization” (Topi et al., 2017, p. 18).

Technically-oriented courses include Data, Information, and Content Management (Gorgone et al., 2006), Systems Development and Deployment (Gorgone et al., 2006), Business Intelligence/Analytics/Data Mining (Topi, 2014), and IT Infrastructure (Gorgone et al., 2006). Data, Information, and Content Management covers competencies in “using structured and unstructured data and information effectively” (Topi et al., 2017, p. 16) and enables graduates to “identify data and information management technology alternatives, select the most appropriate options based on the organizational information needs, and manage the implementation of the selected options” (Topi et al., 2017, p. 16). Systems Development and Deployment can incorporate topics in “the design of information systems and services, including the design of how humans interact with and how they experience IT artifacts” (Topi et al., 2017, p. 19) and in “systems implementation and the deployment of systems to organizational use” (Topi et al., 2017, p. 19). Business Intelligence/Analytics/Data Mining focus on “applications, technologies, architectures, and processes for gathering, storing, accessing, and analyzing operational data to provide business users with timely competitive information to enable better insights for operational and strategic decision making” (Gupta et al., 2015, p. 450). IT Infrastructure covers competencies in performing “needs analysis for and design and implementation of effective, technically correct IT infrastructure solutions” (Topi et al., 2017, p. 19) and enables graduates to “design integrated communication networks for small- and medium-size organizations” (Topi et al., 2017, p.

19).

Finally, Business Continuity and Information Assurance includes topics in “plan and implement procedures, operations, and technologies for managing risk and trust, security, and safety and for business continuity and disaster recovery” (Topi et al., 2017, p. 16) and in “a range of processes from management, such as policy and standard setting, to hands-on skills, such as system contingency and recovery planning” (Topi et al., 2017, p. 16). Further, Business Continuity and Information Assurance can “span from tactical and strategic to technical and operational levels” (Topi et al., 2017, p. 16). Thus, Business Continuity and Information Assurance can address both technical and organizational issues. Technical issues arise because organizations depend on technology, such as encryption and firewall, to protect their information assets. Organizational issues are also present because cybersecurity problems can “exist at organizational levels and have behavioral, economic, policy and planning, management, and legal dimensions” (Goodman, 2014, p. 6:5), meaning there is a need for leadership, management, and communication skills to address security issues (Logan, 2002).

Figure 1 shows that IS master’s programs collectively require more technically-oriented courses than organization-oriented courses. A program with the science, technology, engineering, and mathematics (STEM) designation has higher perceived attractiveness to students and employers, funding possibilities, and program competitiveness (Jones et al., 2019), and “IS educators largely seek STEM designations for master’s programs” (p. 412). Overall, the technical pivot shown by the new descriptive curriculum model is consistent with Jones et al. (2019). At the same time, emphasizing technical concepts over business contents brings short-term benefits but may not facilitate a later transition to more managerial roles that require business skills (Plice & Reinig, 2007). It is important to maintain a balance between technical and business contents (Plice & Reinig, 2007). Examining student attitudes toward graduate IS education, Thouin et al. (2018) obtained survey responses from 184 incoming students matriculating in Fall 2013 in a graduate MIS program at a business school. The authors found that the students preferred an even mix of technical and business coursework.

This new curriculum model affords another perspective on IS master’s programs at large. In the new seven-course curriculum model, most (i.e., five) courses—Data, Information, and Content Management, Systems Development and Deployment, Business Continuity and Information Assurance, IT Infrastructure, and IS Management and Operations—are from MSIS 2016. Thus, the present study’s descriptive curriculum model shows that IS master’s programs still require most coursework to be in traditional IS areas. This result is consistent with a survey of MSIS program directors, many of whom “still consider traditional core IS topics (such as systems analysis and design) to be very important” (Topi, 2014, p. 1).

Concurrently, the popularity of Business Intelligence/Analytics/Data Mining and Business Continuity and Information Assurance show that IS master’s programs are adapting and increasingly require analytics and cybersecurity courses. This trend might have even stronger support if hybrid degree programs, such as “MS in Data Analytics and Information Systems” or “MS in Information Systems and Assurance,” had been included in the analysis. (Recall that they were excluded to improve internal validity.) Thus, this result

pertains only to IS master's programs. Overall, the inclusion of analytics and information assurance and the stability of traditional IS courses, such as data management and systems development, suggest that IS master's programs are adapting to the emergence of analytics and cybersecurity while retaining the long-established IS curriculum. Stated more directly, there is evidence that IS programs are succeeding in adapting to the marketplace—the only two STEM-related occupations in the latest BLS forecast of the 20 fastest-growing occupations between 2020 and 2030 are “Statisticians” (35% with a 2020 median pay of \$92,270/year) and “Information Security Analysts” (33% with a 2020 median pay of \$103,590/year) (BLS, 2021). The evolving curriculum reinforces the belief that “IS programs are dynamic and vigilant, constantly adapting themselves to the changing environment of real-world information technologies” (Gill & Hu, 1999, p. 294).

6.2 Changes in IS Master's Curricula Since Early 2010s

To examine the change in IS master's curricula in the last decade, Table 4 compares the present study's core requirements with those described in a 2012 study (Yang, 2012). In the present study, Data, Information, and Content Management and Systems Development and Deployment have the highest adoption percentages. These results are consistent with those of the 2012 study that used the (then current) MSIS 2006 course “Analysis/Modeling/Design” which combined data management and systems analysis/design into one course (Gorgone et al., 2006). That combined “Analysis/Modeling/Design” had the highest adoption percentage in the 2012 study (88%). Its two constituent courses—Data, Information, and Content Management and Systems Development and Deployment—in the present study continue to have the highest (82%) and second-highest (61%) adoptions. These consistently high percentages of adoption, which have remained high since 2012, suggest that data management and systems development remain essential skills for students to possess. Note that these results only suggest that IS programs treat these courses as essential but do not necessarily reflect industry's view. A future study may examine the priorities as seen from the industry's standpoint.

After these two courses, Project and Change Management has the third-highest adoption percentage of 59%—approximately the same as that in 2012. In a survey of MSIS program directors, managing IT projects has the highest rating of importance for managerial skills and knowledge (Topi, 2014), and project management is a knowledge area in the top five desired skills for entry-level IS employees (Leonard et al., 2019).

The fourth most popular core course is Business Intelligence/Analytics/Data Mining, which is now required by a majority (54%) of IS master's programs—compared to 10% of programs in 2012. Mills et al. (2016) provided “a first empirical examination regarding IS programs moving to big data and analytics” (p. 137) at the *undergraduate* level. The present study now provides complementary evidence on programs requiring analytics as part of their core at the *graduate* level. This result is noteworthy because Business Intelligence/Analytics/Data Mining is not one of the nine competency areas specified by MSIS 2016 (Table 1). One implication of this result is to consider including Business Intelligence/Analytics/Data Mining as part of the IS master's core similar to MSIS 2016's eventual adoption of Business

Continuity and Information Assurance (which was not explicitly called out in the prior MSIS 2006).

Reflecting its presence in MSIS 2016, Business Continuity and Information Assurance is the fifth most popular core course and is required by 47% of programs. The increased popularity of information assurance may be due to the higher visibility of cybersecurity risks facing organizations (Aon, 2019), including ransomware attacks (Popper, 2020). Indeed, IBM Security (2022) found that ransomware has been the most popular attack type for three consecutive years. These risks may prompt organizations to seek IS professionals with at least some business continuity and cybersecurity background. In fact, on a seven-point scale, IS practitioners gave the highest ranking of importance to the security knowledge area for entry-level IS positions (Jones et al., 2019).

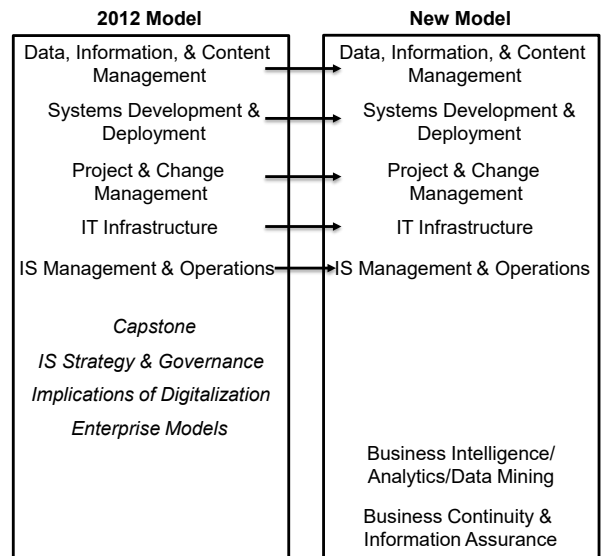


Figure 2. Curriculum Evolution from 2012 (Yang, 2012) to New Model

The evolution of the IS curriculum model at the master's level can be highlighted by comparing the present study's model with that developed a decade ago by Yang (2012). Figure 2 summarizes the evolution of the curriculum model in the last decade. (For clarity, Figure 2 uses the present study's course titles where applicable.) As shown in Figure 2, five courses have remained in the curriculum model since 2012:

- Data, Information, and Content Management
- Systems Development and Deployment
- Project and Change Management
- IT Infrastructure
- IS Management and Operations

Four courses are no longer in the new curriculum model:

- Capstone
- IS Strategy and Governance
- Implications of Digitalization (Gorgone et al., 2006)
- Enterprise Models (Gorgone et al., 2006)

Two courses are emerging in the new model:

- Business Intelligence/Analytics/Data Mining

- Business Continuity and Information Assurance

The five courses that remain in the curriculum are fairly consistent components of the IS core. In fact, all these five courses, except IS Management and Operations, were also in an earlier model curriculum MSIS 2000 (Gorgone et al., 2000). While most of the curriculum model has remained stable, the curriculum also admitted two new courses in analytics and cybersecurity. Overall, the evolution is such that the curriculum continues to be built around a set of stable, traditional courses in both technical and organizational areas. At the same time, the curriculum is changing and adapting, as evidenced by the increasing popularity of analytics and cybersecurity courses. Taken together, the results of this study show that the IS master's curriculum has matured around a set of core courses (Topi et al., 2010b) while continuing to adapt to the dynamic nature of the IS field (Yang, 2012).

6.3 Implications

The results have three implications for the IS community. First, the results of this study are useful to IS educators, curriculum developers, and IS practitioners. For *IS educators*, they may choose new materials to incorporate into their courses based on the results of this study. For example, recognizing that data analytics is emerging (compared to a decade ago) in IS programs, faculty teaching a database course may include a lecture on applying analytics to data stored in databases to generate actionable information. Recognizing the importance of cybersecurity, another faculty teaching a systems development course may include content on secure practices in the analysis and design process. For *curriculum developers*, MSIS programs' collective viewpoint of core courses can inform developers' designs of their institutions' curricula and their understanding of essential knowledge areas to impart to students. This study's results can help determine not only the choice of specific core courses but also the update of an institution's own IS master's program. For *IS practitioners*, the results enable hiring managers to assess the extent to which MSIS programs' core curricula meet their companies' specific demands for IS skills. Organizations can also evaluate a job candidate's background and courses taken based on this new curriculum model.

Second, the results of this study are important because they reveal another perspective on the "core" (Lim et al., 2007, p. 665) of the IS field from a pedagogical and curricular standpoint that is reflected by the resulting descriptive curriculum model and its seven courses (see Figure 1). These core courses are consistent with the basic components of an information system: hardware, software, databases, networks, people, and procedures (Stair & Reynolds, 2017). In particular, Data, Information, and Content Management corresponds to the database component; Systems Development and Deployment corresponds to the software component; both Project and Change Management and IS Management and Operations correspond to people and procedures components, and IT Infrastructure corresponds to networks and hardware components. The newer Business Intelligence/Analytics/Data Mining course covers the extraction of organizational value from databases, whereas the newer Business Continuity and Information Assurance course covers the protection of organizational assets—including databases, hardware, software, and networks—through organizational (i.e., people

and procedures) and technical means. Overall, the descriptive model shows that the IS core is moving toward analytics and cybersecurity because of the emerging realities of the IS practice. At the same time, the field still includes the traditional technical areas of systems analysis and design, database, and IT infrastructure, along with organizational areas of project management and IS management/operations.

Third, the results suggest two paths forward for IS curricula: one path is short-term in focus and the other one long-term. In the *short term*, the community can include data analytics as a future curriculum recommendation for IS master's programs. Of the two emerging courses, Business Continuity and Information Assurance is already called out by the latest MSIS 2016, whereas Business Intelligence/Analytics/Data Mining is not. With empirical data, this study shows that most IS master's programs now require data analytics in their core. In fact, this inclusion may have been anticipated by MSIS 2016, which "recognize[s] that the development of specialized analytics competencies and educational experiences that prepare students to attain them will need to be based on separate efforts" (Topi et al., 2017, p. 39). In the *long term*, the community can address the lag in course updates in curricula because "the impact of IS curriculum-related research articles on curriculum guidelines is inevitably somewhat indirect and slow" (Babb et al., 2021, p. 7). This slowness is incongruent with the fast-changing nature of the IS field. For a path forward, Babb et al. (2021) proposed an ongoing and more continuous process for updating the curriculum. In doing so, they suggested an open-source and open-community approach, by which participating and contributing members engage in discussions and continuously maintain a curricular repository. This "living document" (Babb et al., 2021, p. 15) and open-source community can improve not only the inclusiveness of the curricular modeling process but also the speed by which the curriculum responds to the dynamic nature of the field.

6.4 Limitations and Future Research

A limitation of this study is that it focuses on required courses, but not elective courses. The methodology does include courses if 50% or more of the courses on a list of approved courses are required, so this methodology captures some of the effect of the course choices made by students. Nevertheless, a future study may specifically examine elective courses offered (but not required) to detect, for example, any possible developing topics of teaching interests. Also, the data collection took place during a pandemic, the impact of which on IS curricula is unclear. Because the pandemic may have had larger effects on the *enrollment* rather than the *curriculum* (which has long change/approval cycles), the impact on IS master's curricula themselves may be minimal. Nevertheless, due to the pandemic, organizations spent more on cloud computing to support remote work and put greater emphasis on business-continuity efforts (Loten, 2020a). This means strong hiring in IT infrastructure, development, and security (Loten, 2020b). Future research may specifically address any longer-term effect of the pandemic on curricula.

Another potential research question is whether the emergence of analytics and cybersecurity courses is due to market demand such as Business Intelligence/Analytics/Data Mining (Mills et al., 2016) or is due to the topics' inclusion in MSIS 2016, such as Business Continuity and Information

Assurance. As big data becomes crucial in cybersecurity risk analysis (Choi et al., 2018), future research can determine if market demand contributed to the popularity of these core courses. For example, such research can be in the form of surveying employers' job advertisements (Brooks et al., 2018). Additionally, curriculum tracks are ways by which students can gain a specialization (Topi, 2014). Because this study focuses on required core courses, the tracks offered by MSIS programs are not readily visible in this study. One future research area may focus on specializations offered by various MSIS programs.

Finally, this study's US-centric view is a limitation because IS master's curricula in other parts of the world may reveal different trends and areas of emphasis in specific countries. For example, Elazhary and Morelli (2016) examined 29 IS master's programs in 10 countries across North America, Europe, and Asia. They concluded that programs in the US and Switzerland led in offering courses that better prepare students for "digital transformation readiness" (Elazhary & Morelli, 2016, p. 530). However, this study focuses on programs offered by schools in the US because prior surveys of MSIS curricula have primarily examined US-based institutions (e.g., Apigian & Gambill, 2014; Maier & Gambill, 1997). Another reason for this study's use of US institutions is to examine curricular changes in a consistent set of samples, as the 2012 baseline study for comparison in Table 4 also used US samples of schools. Since this study presents a US-centric view, follow-up studies can examine IS master's programs in other parts of the world to detect any differences in curriculum and factors contributing to those differences.

7. CONCLUSIONS

The topics taught in IS programs, along with practice and research, define the IS discipline. Studying IS master's programs is important because they contribute to IS practitioners' knowledge foundation and can prepare students for entry into doctoral programs leading to a research career. Instead of a random sample, examining the entire population of IS master's programs is a strength of this study. Based on actual data on core courses, the new curriculum model (1) captures the collective view of all IS master's programs at AACSB-accredited institutions and (2) reflects the contents that IS master's programs in aggregate consider to be essential (i.e., core) to their degree recipients. As such, this study contributes to engaging the IS community—including educators, practitioners, and researchers—to "inform a shared understanding of the curriculum" (Richardson et al., 2018, p. 2).

While this new, empirically-based curriculum model provides an academic bottom-up perspective, IS professionals' recommendations can also provide a bottom-up view from an industry perspective. For example, Downey et al. (2008) surveyed 153 IS professionals in practice and developed a curriculum based on their views of the skills students should possess. In addition, top-down curriculum models developed by academic working groups (e.g., MSIS 2016) also add value because they represent a conceptual basis for those contents the discipline should teach. The goal of this study's new curriculum model is not to replace other curriculum models; rather, it is meant to complement them and to serve as part of a diverse set of tools that can be used by curriculum developers, educators,

and researchers to advance our understanding of curriculum requirements and the current state of the discipline, as well as to continuously improve curricula to better serve the community. Moreover, to the best of the author's knowledge, this is the first study that identifies empirical evidence of the emergence of Business Intelligence/Analytics/Data Mining and Business Continuity and Information Assurance in the core of IS master's programs. Such findings can lead to new research questions in curriculum research (e.g., whether these two areas belong in the core of a generalist or a specialist IS master's degree). It is hoped that the results of this study and others can help the IS community advance its understanding of the master's curricula of IS programs.

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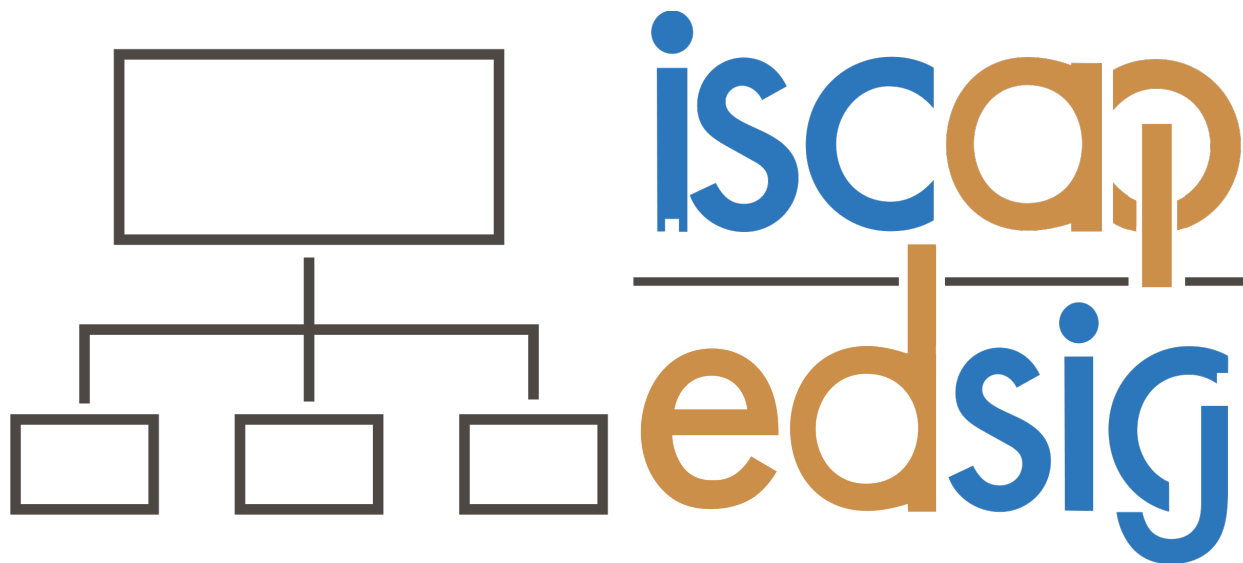
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