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Mary C. Jones
University of North Texas, mary.jones@unt.edu

Mark Srite
The University of Wisconsin-Milwaukee

Ranga Chandrasekaran
The University of Illinois at Chicago

Lakshmi S. Iyer
Appalachian State University

Tim Kayworth
Baylor University

See next page for additional authors

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Authors
Mary C. Jones, Mark Srite, Ranga Chandrasekaran, Lakshmi S. Iyer, Tim Kayworth, and Jason B. Thatcher

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Getting Information Systems Programs Classified as STEM: A U.S.-based Perspective from an AIS Task Force Study and Panel Discussion

Mary C. Jones
Information Technology and Decision Sciences
University of North Texas
mary.jones@unt.edu

Mark Srite
Information Technology Management
The University of Wisconsin-Milwaukee

Ranga Chandrasekaran
The University of Illinois at Chicago

Lakshmi S. Iyer
Computer Information Systems and Supply Chain Management
Appalachian State University

Tim Kayworth
Information Systems
Baylor University

Jason B. Thatcher
Information Systems, Statistics, and Operations Management
University of Alabama

Abstract:

Science, technology, engineering, and math (STEM) is a designation for educational degree programs that have certain benefits that non-STEM programs do not. To achieve a STEM classification, a program must meet certain criteria. Programs in the natural sciences, engineering, and math departments often readily meet these criteria. However, although programs such as information systems, information technology, and business intelligence have technology at their core, these programs, especially in business colleges, often face difficulties in meeting the STEM criteria. In this paper, we review the STEM designation and provide insight into information systems and related degree programs that have received this designation based on findings from an AIS task force and an AMCIS panel discussion.

Keywords: STEM Designation, Program Classification, Information Systems, Business Program, Recruitment, International, Optional Practical Training.

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1 Introduction

Science, technology, engineering, and math (STEM) is an increasingly popular term used to describe rigorous, quantitative information technology-intensive education programs in the United States and elsewhere. In recent years, many information systems (IS) undergraduate and graduate programs have sought "STEM" designation as a means to signal the quality, content, and rigor of the training that they offer to students. The STEM designation helps students because completing a degree in a STEM program signals to employers that a student has completed a degree program that has prepared them well for a career in the IT workforce. To understand the implications for STEM for the IS discipline, the Association for Information Systems created a task group. The task group studied the STEM designation in depth by reviewing the literature, surveying our member institutions, and hosting a panel at AMCIS 2017 in Boston, Massachusetts.

In this report, we summarize our findings, provide a roadmap for understanding the STEM designation, and provide insight into how to secure such designation for IS programs in business schools. To do so, in Section 2, we describe STEM designation and its implications for programs. In Section 3, we provide the results of a national survey that the AIS task group conducted that identifies attributes of IS STEM programs. In Section 4, we provide insights from four universities that established a STEM program. Finally, in Section 5, we summarize the lessons learned, and the 2016-2017 AIS President, Jason Thatcher, discusses STEM designation's strategic value for IS faculty and programs in business schools.

2 What is STEM?

STEM designates educational programs that teach science, technology, engineering, and mathematics. It applies to all levels of education that range from secondary education through doctoral programs. Due to the government's role in STEM designation, we focus in this study on one country: the United States. The U.S. Government established the Committee on Science, Technology, Engineering, and Math Education in 2001 to oversee and facilitate federal programs to support STEM education, and its initiatives shape university programs that seek STEM designation in the US (U.S. Department of Education Archives, 2011). The 2013 Federal STEM Education Strategic Plan laid out the roles of the U.S. Department of Education and the National Science Foundation, among others, in promoting STEM education (National Science and Technology Council, 2013). In addition, the U.S. Department of Homeland Security (DHS) provides a list of STEM-designated degree programs that grant graduates who hold student visas a longer optical practical training (OPT) period than graduates from non-STEM-designated degree programs(U.S. Department of Immigration and Customs Enforcement, 2018).

STEM designations in the US are also tied to Classification of Instructional Program (CIP) codes that aggregate degree programs into a systematic and traceable description of majors that states and the Federal Government use to allocate federal and state formula funding and to compare degree programs across universities. CIP codes categorize the United States' list of DHS STEM-designated degree programs (DHS STEM Codes, 2016). Most business degrees in the US, for example, fall under the 52.xxxx CIP code, while most computer and information technology related degrees (except for management information systems (MIS)) fall under the 11.xxxx CIP code set. To date, the STEM-recognized list includes only a handful 52.xxxx CIP codes, such as 52.1301 (Management Science), 52.1302 (Business Statistics), 52.1304 (Actuarial Science), and 52.1399 (Management Science and Quantitative Methods, Other). The latter code describes various business analytics and related degree programs. However, management information systems programs in colleges of business typically have a CIP in the 52.12xx set as opposed to the CIP 11.xxxx set found in information technology programs in colleges of engineering or information science. Thus, they do not have a STEM-recognized CIP code and, anecdotally, often find it difficult to have their CIP code changed to one in the 11.xxxx set for various reasons (Srite, et al., 2017). IS programs are particularly relevant in the STEM disciplines because, as an interdisciplinary discipline, the IS discipline features various research methods and paradigms. For example, IS research explicitly uses methods such as design science and action research to help foster technology innovation in organizations. Thus, the IS discipline aligns more with other STEM disciplines such as engineering than with business disciplines that build more on empirical or social science paradigms.

However, having a STEM-designated program brings several benefits that make it worth the effort to attain. First, the DHS grants graduates who hold student visas (F-1) with a longer optional practical training (OPT) period, a time during which the United States Citizenship and Immigration Services (USCIS) allows students who have an F-1 visa status and who have completed their degrees or have pursued their degrees for more

than nine months to work on a student visa in order to obtain practical training to complement their education. This period benefits graduates because it allows them to work full time in their discipline for longer and, thus, provides them with more time to gain their work visa status. STEM-designated program graduates can take up to one additional year of time in the OPT period. Thus, all things being equal, a person who holds a student visa tends to prefer a degree program that allows this extra time over one that does not. For example, if a campus offers computer science or computer information technology degrees that have an 11.xxxx CIP code, programs with a 52.12xx CIP code may lose majors that they otherwise could attract.

In addition, large funding sources such as the National Science Foundation (NSF) offer scholarships and other funding specially designated for STEM programs. Even though a program may teach the same or similar things that a STEM program does, it may not qualify for this money unless it has the designation. Researchers who work in STEM disciplines can also access research grants that other researchers cannot: even if two researchers conduct the same type of research, the one who does not work in a STEM-based degree program may not be qualified to apply for these grants. For example, the National Science Foundation has many opportunities for STEM-based funding that it makes available to those who work in STEM-designated programs. Thus, two key reasons to become a STEM-designated program exist: to recruit more international students (increased enrollment) and to gain access to federal funding opportunities for scholarships, programs, and research.

3 Survey Findings from STEM Designated Programs

In 2016, the Association for Information Systems (AIS) created an AIS STEM task force charged with assessing the state of STEM designations across information systems and related programs. As part of this work, the task force sent a survey to AIS members in the US to gather information about STEM programs. The task forced conducted the survey to 1) provide an exploratory snapshot of STEM in information systems and related programs that often face difficulty in obtaining STEM designation in order to better understand how schools attain the designation and to document obstacles towards its attainment and 2) sufficiently understand these STEM designations to provide a foundation on which future researchers could conduct a broader global study. We received 47 responses; after removing duplicates and non-information systems related programs, 41 usable responses remained. Most of the respondents had, or were, pursuing STEM designation for one or more of their programs. We do not find the small number of respondents surprising given the perceived difficulty of garnering this designation. Schools without STEM-designated programs, for example, may have not responded because they did not believe it pertained to them or that they were not qualified to answer the questions. However, because this study is exploratory, the data does provide a useful snapshot.

Respondents largely came from public universities (78%) and worked in a college of business (80%), a college of information (5%), a college of engineering (5%), and other colleges/schools (10%). Regardless of the college in which they worked, most respondents worked in a department that combined both the IS and various other disciplines (see Table 1).

Table 1. Departments in Which Respondents Worked

Department	Respondents (in %)
Information systems/information technology combined with business analytics/analytics	33%
Information systems/information technology combined with decision/management science	20%
Information systems/information technology only	13%
Information systems/information technology combined with operations management/management	10%
Information systems/information technology combined with computer science	3%
Accounting	5%
Other (largely information systems with another discipline not listed above)	15%

We also found that our respondents' institutions offered various degree programs (see Table 2). At the undergraduate level, the largest percentage of respondents offered a degree in information systems/information technology (79%), while the second largest percentage offered a concentration or track in business intelligence, business analytics, or data science (48%). At the master's level, the largest

percentage of degree programs offered a master of science in information systems/information technology (61%). We also asked respondents whether they offered doctoral granting programs and found that 48 percent did and 52 percent did not.

Table 2. Degree Programs Offered

Undergraduate	Respondents (in %)
A degree in information systems or information technology	79%
A degree in business intelligence, business analytics, or data science	28%
A degree in operations management, decision sciences, or management science	10%
A concentration or track in information systems or information technology	21%
A concentration or track in business intelligence, business analytics, or data science	41%
A concentration or track in operations management, decision sciences, or management science	10%
A certificate in information systems or information technology	7%
A certificate in business intelligence, business analytics, or data science	21%
A certificate in operations management, decision sciences, or management science	0%
Other	13%
Masters	
An MS in information systems or information technology	61%
An MS in business intelligence, business analytics, or data science	39%
An MS in operations management, decision sciences, or management science	4%
An MBA in information systems or information technology	21%
An MBA in business intelligence, business analytics, or data science	7%
An MBA in operations management, decision sciences, or management science	4%
A concentration or track in information systems or information technology	25%
A concentration or track in business intelligence, business analytics, or data science	39%
A concentration or track in operations management, decision sciences, or management science	7%
A certificate in information systems or information technology	14%
A certificate in business intelligence, business analytics, or data science	36%
A certificate in operations management, decision sciences, or management science	4%
Other	21%

Respondents' institutions also largely offered at least one STEM-designated degree program (61%). Only two percent were awaiting approval for STEM designation and only five percent were considering pursuing it. However, 15 percent reported not having thought about STEM designation, and 17 percent did not know whether their programs had STEM designation. No one reported that they decided not to pursue the designation nor that they had tried and failed. Thus, our respondents either had (or were working on obtaining) STEM designation, had not thought about attaining STEM designation, or did not know about whether their program had STEM designation. Of those who had received STEM designation, 35 percent had three STEM designated degree programs, 35 percent had two, and 29 percent had one.

Of the STEM-designated degree programs, 34 percent were undergraduate programs, 62 percent were master's programs, and three percent were doctoral programs. Most programs were information system/information technology programs (55%) followed by business analytics programs (27%) and other analytics/quantitative programs (18%). Of the fourteen respondents who reported a STEM CIP code, 50 percent had one in the 11.xxxx set, 14 percent had 52.1301 (management science), and 29 percent had 52.1399 (business analytics). Table 3 lists the degree programs with STEM designation in detail.

Table 3. Degree Programs with STEM Designation

Program	Respondents (in %)
Undergraduate in information systems/information technology	15%
Undergraduate in business analytics	9%
Undergraduate in operations/quantitative modeling/other analytics related	3%
Undergraduate in information science	3%
Master's in information systems/information technology	24%
Master's in business analytics	15%
Master's in other quantitative methods/analytics	12%
Master's in data science	3%
Master's information technology audit/cyber security	3%
Level not specified (CIS, BA, logistics and supply chain)	12%
PhD in IS	3%

We also asked respondents what benefits they perceived a STEM-designated program to have (see Table 4). The most widely mentioned benefits included increased attractiveness to students and employers, increased funding possibilities, and increased program competitiveness. Interestingly, no one perceived STEM designation to affect how university administrators perceive a program.

Table 4. STEM-designated Program Benefits

Benefit	Respondents (in %)
Increased attractiveness to students	72%
Expanded opportunities for federal or state program/scholarship/curriculum funding	59%
Increased attractiveness to employers	59%
Enhanced competitiveness of the program	55%
Expanded opportunities for federal or state research funding	52%
Extensions to OPT opportunities	52%
Increased attractiveness to guidance counselors and others who advise potential students about majors	28%
It affects the perception of the program among university administrator and leaders	0%
Don't really believe there are many benefits	3%

We also specifically asked respondents to rate how important they perceived STEM is to attract students. The vast majority said it was extremely important (47%) or very important (27%). We might expect such a result from a set of respondents who mostly resided in STEM-designated programs. However, 16 percent said it was either moderately or slightly important and another 10 percent said it was not important at all.

Because attractiveness to students and enhanced competitiveness represent two widely touted benefits of STEM designation, we asked respondents how they recruited students in general (see Table 5). The vast majority of respondents used university- or college-sponsored fairs on campus to recruit students (90%). Over half also used department-sponsored fairs on campus (55%) and university fairs off campus (52%) to recruit students. Nearly one-half (48%) used social media outreach.

These survey findings paint a picture in which IS educators largely seek STEM designation for master's programs, although many respondents had more than one STEM-designated program. Most of these master's programs with STEM designation had a CIP code in the 11.xxxx set, which we find somewhat surprising given the large number of business analytics programs the respondents reported. Based on the heavy reliance on non-departmental specific recruiting and on-campus recruitment fairs, it appears that these programs have not heavily focused on promoting their STEM designation even though they reported increased enrollment as a top reason for obtaining it. It appears that, even after reclassifying programs to meet STEM criteria, many programs have yet to fully take advantage of the opportunities that this designation provides.

Table 5. Student-recruiting Activities

Recruiting activity	Respondents (in %)
University- or college-sponsored on-campus recruitment fairs or information sessions	90%
Department-sponsored on-campus recruitment fairs or information sessions	55%
University- or college-sponsored off-campus recruitment fairs or information sessions	52%
Social media outreach	48%
Contact with high-school or other career counselors	31%
Targeted mail-outs	31%
Department-sponsored off-campus recruitment fairs or information sessions	28%
Hard copy advertising (e.g., magazines, newspapers, etc.	21%
Robo-camps or other events to attract students to your major	7%

4 How to Become STEM Designated: Lessons from the Field

In this section, we provide examples of the STEM-designation process from various business schools that have recently had information systems and related programs designated as STEM. We originally presented three of these examples at an AMCIS panel that arose out of the AIS STEM task force (Srite et al., 2017). The fourth example did not appear in the panel but represents the experience of a panel and task force co-chair. In addition, the 2017-2018 AIS President, Jason Thatcher, provided a perspective on STEM in IS-related degrees at the panel. Because the panel focused on garnering STEM designation for IS-related programs that often face difficulty in fitting the criteria, all programs resided in a college of business. Further, the programs included undergraduate, master's, and doctoral programs. Three of the experiences were from public universities, and one was from a private university. These experiences across type of university and degree programs serve to provide a cogent set of lessons learned that may benefit others who begin the process of obtaining STEM designation for one or more programs.

4.1 University of Illinois at Chicago Experience: Master's in MIS

The Master of Science (MS) program in MIS at the University of Illinois at Chicago (UIC) has recently obtained STEM designation. The process for obtaining this certification comprised several steps. First, faculty reviewed the existing curricula and course content. Second, they analyzed existing courses in the program to assess the extent of STEM content in them. Third, they revised and updated courses (where necessary) to improve their STEM content. Next, they redefined core and elective courses and, simultaneously, achieved alignment with the AIS model curriculum (see www.msis2016.org).

At this point, faculty needed to decide on the appropriate CIP code. Initially, the program had the typical non-STEM CIP code for MIS programs in business schools 52.12xx (Management Information Systems and Services). Faculty could choose from the following STEM-designated CIP codes options for MIS/analytics programs:

- 11.0101 Computer and Information Sciences, General
- 11.0701 Computer Science
- 11.0501 Computer Systems Analysis/Analyst
- 11.1099 Computer/Information Technology Services Administration and Management, Other
- 52.1301 Management Science
- 52.1302 Business Statistics
- 52.1399 Management Science and Quantitative Methods, Other

To decide on which code (among the above options) to use, faculty had to ensure that the CIP code was based on the program's content, that it did not conflict with similar programs (computer science, informatics, etc.) in the same university, and that it was similar to the code that other MIS programs in the same geographic environment used. The process then moved on to preparing the paperwork. Finally, faculty needed to formally establish how their program and courses fit into STEM criteria and to map courses to specific codes. Table 6 shows an example for three courses.

Table 6. Sample Course Mapping for STEM Designation

Course	Course description	Links to CIP descriptions and codes
IDS 517 Enterprise Application Development (Core Course)	The course explores the choices available for building an enterprise application. The course covers topics such as advanced applications design and development tools, methodologies, and technologies. Students need to extensive use computers.	Computer Programming—Specific Applications (11.0202) Languages Programming (11.0501) Programming and Debugging Techniques (11.0501) Emerging Web Technologies (11.0801)
IDS 520 Enterprise Infrastructure Planning & Security (Core Course)	This course introduces students with methods and practices involved in planning, designing, and securing information infrastructure commonly found in large and medium enterprises.	Security Needs of Computer and Network Systems (11.1003) Risk Assessment and Policy Analysis (11.1003) Security System Design (11.1003) Recommend Safeguard Solution (11.1003) Manage the Implementation and Maintenance of Security Devices, Systems, and Procedures (11.1003)
IDS 521 Advanced Database Management Systems (Core Course)	Data analysis for database design; logical data modeling, transaction modeling; implementation models; physical database design; database tuning and performance based evaluation; database decomposition; distributed database; database security.	Data Modeling/Warehousing and Administration (11.0802) Manage the Construction of Databases (11.0802) Instruction in Database Theory (11.0802) Database Development (11.0401) Process and Dataflow Analysis … and Specification Design (11.0501) User Needs Analysis and Documentation (11.0501)

Another part of the process included market research. UIC gathered information about similar programs and respective CIP codes from peer institutions in Chicago and across Illinois and the United States. Faculty obtained detailed information on STEM content in similar MIS programs, their CIP codes, and the paperwork to comparatively assess UIC's program with the programs in its peer institutions. The STEM designation also went through a lengthy approval process that began with the department of Information and Decision Sciences and ended with the Illinois Board of Higher Education (IBHE). More recently, UIC established a new master's program in business analytics. The approval process for the new program included a STEM designation and corresponding CIP code approval.

UIC observed several potential benefits from the STEM designation, such as increased grants for program and curriculum development, better faculty development, the attraction of a greater number of minority and underrepresented groups to STEM, better access to student loans, and the attraction of a higher number of international students.

4.2 Appalachian State University and University of North Carolina at Greensboro Experiences: Undergraduate and Master's Programs

Appalachian State University (ASU) obtained STEM designation for its Master of Science (MS) in Applied Data Analytics (MSADA) program at the time it established the program. However, the undergraduate Computer Information Systems (CIS) degree program at Appalachian State University did not have STEM designation because it had a Bachelor of Science in Business Administration (BSBA) designation with a CIP code of 52.1201 (i.e., a general management degree). However, the program strongly emphasized computing and scientific knowledge in addition to business acumen. A similar undergraduate program for the IS major at the University of North Carolina at Greensboro (UNCG) had STEM designation because it had a Bachelor of Science (BS) designation with a CIP code of 11.0901. Choosing the appropriate CIP code ensures a program achieves STEM designation and meets the DHS's designation for the OPT period. Table 7 lists potential CIP codes that IS/IT, MIS/CIS, and analytics programs can consider.

Table 7. CIP Codes to Consider IS/IT Programs

11	11.0101	Computer and Information Science, General
11	11.0102	Artificial Intelligence
11	11.0103	Information Technology
11	11.0104	Informatics
11	11.0199	Computer and Information Systems, Other
11	11.0201	Computer Programming/Programmer, General
11	11.0202	Computer Programming, Specific Applications
11	11.0203	Computer Programming, Vendor/Product Certification
11	11.0299	Computer Programming, Other
11	11.0301	Data Processing and Data Processing Technology/Technician
11	11.0401	Information Science/Studies
11	11.0501	Computer Systems Analysis/Analyst
11	11.0701	Computer Science
11	11.0801	Web Page, Digital/Multimedia and Information Resources Design
11	11.0802	Data Modeling/Warehousing and Database Administration
11	11.0803	Computer Graphics
11	11.0804	Modeling, Virtual Environments and Simulation
11	11.0899	Computer Software and Media Applications, Other
11	11.0901	Computer Systems Networking and Telecommunications
11	11.1001	Network System Administration/Administrator
11	11.1002	System, Networking, and LAN/WAN Management/Manager
11	11.1003	Computer and Information Systems Security/Information Assurance
11	11.1004	Web/Multimedia management and Webmaster
11	11.1005	Information Technology Project Management

Faculty at ASU needed to perform several steps to obtain STEM designation for their programs. Specifically, for new programs, faculty needed to:

- Review the curriculum and ensure learning outcomes match topic coverage based on CIP codes
- Discuss personnel and policies with the university's office of assessment and accreditation
- Assign an appropriate code in program proposal documents

The process for existing programs differed slightly and required faculty to:

- Review the curriculum and ensure learning outcomes match topic coverage based on CIP codes
- Discuss personnel and policies with the university's office of assessment and accreditation
- Fill appropriate forms to request a change in CIP code and program prefix (such as BS or MS) and justify the change
- Follow the internal routing process and obtain system-level approval
- Discuss the change with faculty who organize financial aid and international programs to minimize potential problems that a new STEM-designated program could have on such programs.

Both ASU and UNCG realized several benefits from obtaining STEM designation for their courses, such as better equipping students to compete for jobs in the growing STEM discipline, providing students with a job market advantage due to the consistent employee demand for STEM graduates, providing faculty with potential access to federal grant opportunities that can address STEM needs, providing students with access to higher-paying jobs, and appealing more to international students. Increased numbers of international students arose due to several reasons. Further, the panelist noted that the panelist had received a NSF grant in part due to belonging to a program that had STEM designation. These reasons can

include participation in the extended 36-month period (including the 24 months extension) of Optional Practical Training, but this extension is only for CIP codes designated STEM as they appear on the DHS STEM Designated Degree List. In addition, only individuals who hold a degree from a US institution certified as STEM designated can participate (degrees obtained outside the United States are not eligible for STEM extensions). A final benefit for the panelist was a recent NSF grant that was due, in part, to belonging to a program that had STEM designation.

4.3 Baylor University Experience: Undergraduate, Master's, and PhD Programs

Baylor University (BU) provided some unique information about obtaining STEM designation. First, as private university, it found some aspects of the designation process easier but experienced other unique difficulties. Second, BU, in addition to certifying its Master's Program in Information Systems, elected to also designate its PhD in Information Systems as STEM, which universities do not commonly do. Third, they received approval to designate their Bachelor of Business Administration (BBA) in Management Information Systems as STEM before the university later rescinded it.

BU's experience indicates that the STEM approval process may differ significantly between public and private universities. One difference lies in the structure of the approval process. Whereas public universities typically have highly structured and often lengthy review processes, private institutions may have an approval process that lies with one single administrator or office at the university level. However, while such a benefit may enable private schools to be more nimble and make decisions quickly, it may also serve as a disadvantage if no clearly defined process for STEM approval exists. At BU, the process began in 2008 when the department chair wrote a letter of explanation addressed to a vice-provost that presented the argument for why the undergraduate MIS, the master's MSIS, and PHD information systems programs should all be reclassified from the non-STEM CIP codes of 52.1201 (Management Information Systems, General) to STEM CIP codes (11.xxxx). This letter mapped courses to specific STEM CIP codes and requested approval for STEM classification for all three programs. The university administrator approved the request and the university enacted it fairly quickly.

However, in 2015, the university hired a new administrator who reviewed all program designations and determined that the MIS programs did not meet STEM content criteria and required them to revert their classification to the original business program CIP code of 52.1201. Thus, in a private university, decisions about program STEM approval may depend on the perceptions of a small group of people and, therefore, more subject to individual interpretation. Furthermore, the requestors in the discipline have the responsibility to educate administrators about the discipline and why it should be considered STEM. The MIS faculty at BU began to educate the new administrator about what they taught in the MIS major. In the end, they maintained STEM-designated CIP codes for the PhD and MSI, but not the undergraduate MIS major.

4.4 University of North Texas Experience: Undergraduate and Master's Programs

The Information Technology and Decision Sciences Department in the College of Business at the University of North Texas created a Bachelors of Business Administration (BBA), a Master of Science (MS), and an MBA in Business Analytics over the last five years. Due to the way the department created the programs, the BBA and MS had CIP codes of 52.1201. Further, the Bachelor of Science in BCIS had existed for over three decades and also had a CIP code of 52.1201. The department created the MBA in business analytics as a concentration under the College of Business MBA program; thus, it also had a non-STEM CIP code. The department first garnered STEM designation for the BBA and MS in Business Analytics by requesting to change the CIP code for these programs to 52.1399—the CIP code associated with business analytics degrees and recognized as STEM. The process resembled the other processes described here. First, faculty obtained department approval, then College of Business curriculum committee approval, and finally college approval. Next, faculty obtained approval from the respective university undergraduate and graduate curriculum committees and from the vice president of academic affairs (provost). Next, the university system provost approved and forwarded the request to the state board that oversees higher education in Texas (the Texas Higher Education Coordinating Board). Once the programs received this approval, the programs officially became STEM designated, and the university could promote them as such.

The MS saw the greatest benefit in that it received triple the number of applications in the summer following the approval in spring. In addition, faculty who applied for some federally funded research grants that only principal investigators (PI) may apply for at schools with a STEM-designated program could apply as a PI on their own without the need to work through other programs on campus that may or may not have been germane to the grant work.

After realizing the initial benefits that STEM designation for these programs created, the department went through a similar process to garner STEM designation for the BS in BCIS and the MBA in Business Analytics. As with other MIS-related programs, the department decided to pursue an 11.xxxx CIP code for the BS degree after first changing the CIP codes on the courses taught to 11.xxxx from 52.1201 CIP codes. The process for the MBA differed slightly because it also required obtaining approval at each step to separate the MBA in Business Analytics from the College of Business MBA umbrella such that it could stand on its own as an MBA with a CIP code of 52.1399. At the time of writing, the changes for the BS and the MBA were in the approval process. The department expected increased enrollments and benefits to international students in terms of an extended OPT.

5 Lessons Learned

Key lessons learned from the experiences of these four programs for department chairs and program directors when seeking STEM approval include:

- Do your homework beforehand. Find out who makes decisions at your school for STEM program approval and if an approval process in place even exists.
- Carefully construct your argument as to why your program(s) should receive STEM designation, which includes mapping specific courses to CIP codes while considering course content.
- Focus on educating those who must approve your STEM request as to why your program merits STEM designation. For example, if you work in a "Management Information Systems" department or if you use "MIS" as your course prefixes, administrators may believe that non-STEM 52.1201 CIP code best describes your programs. Take the time to explain why, for example, 52.1201 does not represent your major. For example, the Baylor University department chair made this argument in his original request letter regarding the 52.1201 CIP code:

The focus of 52.1201 on operational management of technology manifests itself in such wording as: "report preparation, computer facilities and equipment operation and maintenance, operator supervision and training, and management information systems policy and planning". While these are certainly important learning concepts, this is not the focus of our core degree programs.

- In addition to doing your homework and educating administrators, chairs and program directors should be prepared to enlist the support of their deans/associate deans to advocate for their position with administrators.

Although the specific process of obtaining STEM designation that we describe may be specific to the US, governments in many countries implement policies to foster education in STEM disciplines, and the broad lessons from our findings on aligning information technology courses and programs with STEM content pertain to programs worldwide. STEM itself does not pertain only to the US as the growing attention paid to its importance around the world evidences. For example, the Agency for Science, Technology and Research (A*STAR) in Singapore brings together public sector agencies, universities, and their own research institutes to work with the private sector to enable companies to leverage technology to be globally competitive and includes data analytics and other information technologies (Poh, 2018). In another example, the Chinese Government seeks to lead the world in innovation by 2050 (Han & Applebaum, 2018). Higher education institutes that offer STEM programs and research are set to play a major role in reaching this goal.

5.1 AIS 2017-2018 President Perspective

In general, the IS discipline has a positive status. Enrollments have increased and the job market remains strong due to a robust job market for traditional IS students and new opportunities for trending topics such as analytics. However, some overall challenges remain. The IS discipline has experienced many cycles, which has resulted in weak job markets seeming to appear about every ten years. The perception that the skills we teach can be outsourced also exists. Finally, we lack clarity about where our discipline fits in the information systems/computing landscape. Are we a business discipline or a computing discipline?

The STEM designation provides a disciplinary opportunity. It can smooth out the cycles that I mention above by tapping into a national priority (not just in the US) for STEM education and help students and faculty obtain visas during times when domestic enrollment and recruitment decreases, the STEM designation can also clarify what the IS discipline teaches. While we routinely study how to develop, apply, and use information technologies to enable human and organizational performance, potential students, their parents,

and their future employers may not know that many of our graduates enter the IT workforce ready to work in applied and technical positions in programming, analytics, and more. Finally, with STEM designation, we can differentiate ourselves from other business disciplines by providing a distinct identity for our students vis-à-vis their peers and give our deans talking points with industry.

With respect to the recent trend toward STEM designation, the AIS should aggregate information on experiences and processes required to earn STEM, provide opportunities for schools to earn this designation, support schools that seek to have programs and departments earn STEM designation, and underscore that they do not need to seek STEM designation to be an IS program and that the discipline benefits from heterogeneity. AIS serves as a platform for advancing all programs that study or teach IS and related topics in academe, and aggregating information that helps programs transform themselves to earn STEM designation represents just one way that we serve the discipline.

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About the Authors

Mary C. Jones is Professor of information systems in the Information Technology and Decision Sciences Department at the University of North Texas. Her work appears in numerous journals including *MIS Quarterly, European Journal of Information Systems, Behavioral Science, Decision Support Systems, System Dynamics Review,* and *Information and Management*. Her research interests are primarily in the impact on organizations of large scale, organizational spanning information systems such as ERP or business intelligence/analytics systems. She teaches a variety of courses including Enterprise Applications of Business Intelligence/Analytics, IT Project Management, and doctoral seminars on General Systems Theory and on research methods.

Mark Srite is an Associate Professor in the Lubar School of Business at the University of Wisconsin – Milwaukee. His research is focused in the areas of technology acceptance across national cultures and strategic issues in enterprise systems adoption. He has published in *Management Information Systems Quarterly*, the *Journal of Management Information Systems*, the *Journal of the AIS*, *Decision Support Systems*, *Information & Management*, *IEEE Transactions on Engineering Management*, and elsewhere.

Ranganathan (Ranga) Chandrasekaran is a Professor of MIS and Director of Graduate Studies at the University of Illinois at Chicago (UIC). He is also the Director of the Center for Healthcare Information Management and Systems (CHIMS) at UIC. His areas of expertise include Healthcare IT, Social Networks, Electronic security and privacy, and IT-enabled organizational transformation. He has published extensively in journals such as *Information Systems Research*, *European Journal of IS*, *MIS Quarterly Executive*, D*ecision Sciences Journal*, *IEEE Transactions on Engineering Management*, *Journal of Information Technology*, andothers. His work has been funded by grants from National Science Foundation, Illinois Office of Healthcare IT, IBM, Electronic Document Scholarship Foundation, among others.

Lakshmi S. Iyer is Professor of IS and Director of Graduate Applied Data Analytics Programs in the Walker College of Business, Appalachian State University, NC. Her research interests are in the role of emerging technologies and social inclusion in IS. Her research work has been published in the *JAIS, EJIS, Communications of the AIS, Communications of the ACM, DSS, eService Journal, JECR,* and others. She is founder director of two STEM outreach programs, Women in IT (wiit.uncg.edu) and Innovate for Good (innovate.appstate.edu) that furthers the role of underrepresented students in IT. Her recent NSF award engages diverse middle school youth and teachers in out-of-school learning that integrates science, engineering, and computing to address environmental problems. She received the 2011 Dr. Shirley Hall Award from AAUW Greensboro Branch and 2015 National Center for Women in IT's 2015 Educator Award for her exemplary contribution to enrich STEM education for women.

Timothy R. Kayworth is a Professor of MIS and Associate Dean for Graduate Business Programs at the Hankamer School of Business (https://www.baylor.edu/business/), Baylor University, Waco, Texas. His research interests center on IT strategy & governance as well as the role of culture in IS and has been published in M*IS Quarterly, MIS Quarterly Executive, the Journal of MIS, European Management Journal* and others. His current research examines the phenomenon of shadow IT in organizational data analytics initiatives as well as studying the career paths of female information systems executives to better understand their pathway to leadership in the STEM discipline.

Jason Bennett Thatcher is the Endowed MIS Professor of Management Information Systems in the Department of Information Systems, Statistics and Operations Management at the University of Alabama. He is a Senior Editor at *MIS Quarterly* and a member of the editorial board of the *Journal of the AIS*. His work appears in *MIS Quarterly*, *Information Systems Research*, *Journal of the AIS*, *Journal of Applied Psychology*, *Organizational Behavior and Human Decision Processes*, and in other outlets. He has served as President of the Association for Information Systems.