

# The Information Systems Core: A Study from the Perspective of IS Core Curricula in the U.S.

Drew Hwang  
dhwang@csupomona.edu

Zhongming Ma  
zma@csupomona.edu  
Computer Information Systems Department  
Cal Poly Pomona  
Pomona, CA 91768, U.S.A.

Ming Wang  
mwang3@exchange.calstatela.edu  
Information Systems  
California State University, Los Angeles  
Los Angeles, CA 90032 , U.S.A.

## Abstract

To keep up with technology changes and industry trends, it is essential for Information Systems (IS) programs to maintain up to date curricula. In doing so, IS educators need to determine what the IS core is and implement it in their curriculum. This study performed a descriptive analysis of 2,229 core courses offered by 394 undergraduate IS programs in the United States. The result presents a panoramic snapshot of the IS core in the nation from the perspective of IS core curricula. By mapping those core courses to the most recent IS model curriculum, IS 2010, this study also reports how many IS programs offer each of the seven core courses in IS 2010. Moreover, these core courses were examined from three different perspectives: school type, accreditation, and research orientation.

**Keywords:** IS Core, IS Curriculum, IS 2010

## 1. INTRODUCTION

Since the Information Systems (IS) curriculum was founded, it has evolved significantly over the past fifty years (Longenecker et al., 2012). At the same time, IS scholars have been concerned about the nature and scope of the discipline. Benbasat and Zmud (2003) stimulated a passionate debate about whether the IS field is in an identity crisis, and the debate continues (Helfert, 2011; Kohun et al., 2012). Faculty in IS higher education always

face a curriculum dilemma: They need to constantly update their curricula in order to keep up with changing technologies and industry trends while struggling to discover the IS identity.

There are generally two essential approaches to the IS curriculum structure: to offer a broad spectrum of knowledge and skills in various required courses, or to take a breadth-first and specialization-second approach in which students are required to complete a set of core

courses in a fundamental body of knowledge followed by a number of electives in a specialized area (Hwang & Curl, 2013). In either case IS educators have to determine what the common core of knowledge is and what the specializations are.

Early IS curriculum models focus on the common core of knowledge, while the most recent IS 2010 curriculum model (Topi et al., 2010) provides greater flexibility by separating the core of the curriculum from career track electives. Because of the wide coverage of information technologies and the constraint of the limited number of units in a program, the separation of core and track electives is considered sound and practical. However, due to the dynamic nature of the discipline, what constitutes the common core of knowledge deserves a periodic examination.

This paper is set to continue the work of determining what the IS core is by examining the core course offerings of the existing IS programs in the U.S. The study intends to present a snapshot of the IS core from the curriculum perspective by referring to the framework of the seven core courses defined in the IS 2010 curriculum model. Furthermore, the study examines the existing IS core from three different perspectives, school type (i.e., public vs. private), accreditation (i.e., AACSB accredited vs. not AACSB accredited), and research orientation (i.e., with a Ph.D. program vs. without a Ph.D. program)

## 2. Related Literature

Based on Jones's (1997) analysis of the IS literature, two approaches can be used to study IS curriculum: *normative* and *descriptive*. The normative approach seeks to determine factors that affect IS curriculum design and to develop normative standards for the curriculum. Research taking the descriptive approach describes IS courses or programs. The studies in IS core in terms of core subjects or actual courses have basically followed these two approaches.

### Normative IS Curriculum Studies

Using the normative approach, the Association for Computing Machinery (ACM), the Association for Information Systems (AIS), and the Association for Information Technology Professionals (AITP) developed and updated large scale curriculum models such as IS 1997

(Davis et al., 1997), IS 2002 (Gorgone et. al., 2002), and IS 2010 (Topi et al., 2010). The IS 1997 and IS 2002 models suggested a standard of reference to IS core topics, while the most recent model, IS 2010, offered guidance to both topics in core and electives. IS 2010 contains the following seven core courses:

- 2010.1 Fundamentals of Information Systems
- 2010.2 Data and Information Management
- 2010.3 Enterprise Architecture
- 2010.4 IT Infrastructure
- 2010.5 IS Project Management
- 2010.6 System Analysis and Design
- 2010.7 IS Strategy, Management, and Acquisition

Many other normative studies (e.g., Maier, Clark, and Remington, 1998; Moshkovich, Mechitov, and Olson, 2005; Golden and Matos, 2006, etc.) proposed that certain knowledge areas or skill sets should be part of the IS core due to business model changes, technological advancements, and job market movements.

Studies using the normative approach have provided a useful reference point for IS curriculum design and development. Although together they represent a best practice model for the content of IS programs, they primarily leave the implementation of the model up to each school. Therefore, the normative studies, in their prescriptive nature, do not reflect the actual image of the IS curricula at large.

### Descriptive IS Curriculum Studies

Research taking the descriptive approach views IS as a "socially constructed field" (Lim et al., 2007) constituted and defined by members who can identify themselves as "organizational stakeholders" (Sidorova et al., 2008) of the IS community. From this premise, IS core can be inductively derived from the IS's socially constructed knowledge base embedded in the composition and editorial policies of IS journals as well as the structure of IS curricula designed and developed by IS educators.

Lim et al. (2007), for instance, analyzed the abstracts and titles of 1,197 IS studies in three premier IS journals from 1980 through 2005 to identify the core terms of the field and explored their evolving nature. The study identified eleven field core terms including Information, Organization, System, Model, Process, Management, Data, Decision, User,

Development, and Strategy. Sidorova et al. (2008) also examined the abstracts of research papers published in three top IS journals from 1985 to 2006 and identify five core areas: Information Technology and Organizations, IS Development, IT and Individuals, IT and Markets, and IT and Groups.

As an important stakeholder, the IS educators are likely to closely identify with the IS discipline. IS curriculum reflects an intellectual filtering of knowledge and skill elements by faculty who decide what students should learn for their future careers. Thus, IS curricula authored by the IS educators can also be considered as the stakeholders' reflection of the IS core. Several studies in the last two decades were conducted from this perspective to investigate existing IS core and, in some cases, compared them with IS model curricula.

Maier and Gambill (1996), for instance, collected curriculum data from a sample of 43 out of 108 AACSB-accredited universities in CIS/MIS in the U.S. to identify the most common courses taught. As a result, their analysis identified a profile of typical IS core offerings consisted of courses such as COBOL I and II, Database Management Systems, Data Communications, Data/File Structure, Decision Support Systems, IS project and IS Concepts, as well as Management of IS, Micro-applications, and Systems Analysis and Design. Porter and Gambill (2003) examined the websites of 222 IS undergraduate programs in the U.S. to discover courses required for IS majors and compared them with the IS 2002 curriculum model. Their findings indicated a higher level of alignment between Programming, Database, and Systems Analysis and Design courses, while the alignment between Data Communications, Computer Concepts, Internet, and Micro-applications courses is weaker. In another attempt, Kung et al. (2006) reviewed university course catalogs of 232 IS undergraduate programs in the U.S. and find that the most common core courses include Introduction to IS, Operation Systems, System Analysis and Design, Programming, Database, Telecommunications, and IS Capstone Course. Lifer et al. (2009) also reviewed websites of a sample of 100 IS programs in the U.S to identify the most common IS requirements. The study revealed that Database, System Analysis and Design, Programming Languages, and Networks/Data Communication were the most required IS courses. Stefanidis and Fitzgerald

(2010) examined 228 programs from 85 universities in the U.K. and reported the course mapping results according to IS 2002.

In a more recent study, Apigian and Gambill (2010) reviewed curriculum data from websites of 240 IS programs in the U.S. They found that there was a persistent set of core courses that most schools were teaching for the past 15 years. These courses included IS Fundamentals, Database, Systems Analysis and Design, Network Communications, and Programming. As another recent study, Bell et al. (2013) collected curriculum data from university websites and course catalogs of 127 AACSB-accredited IS programs in the U.S. and compared it with the IS 2010 model. The result revealed that IS programs in the nation exhibit a wide range of adherence to the IS 2010 core curriculum guidelines.

Despite the prior work on IS curricula, as acknowledged by Helfert (2011) in a comparative study in IS curriculum, "an ongoing discussion about essential foundations and concepts is required and, due to the dynamics of the discipline, periodical reviews are essential."

### 3. METHODOLOGY

This study used the university websites as the data source. The use of online information from university websites, such as web-based catalogs, has four advantages: the content is official; the return rate is 100%; the respondent's memory or interpretation is irrelevant; and it is timely and cost-effective. This form of content analysis, as a popular research methodology in the electronic age, made it possible to accurately capture and verify curriculum data (Kim and Kuljis, 2010).

To the best knowledge of the authors, an official complete list of IS undergraduate programs in business schools in the U.S. did not exist. However, a comprehensive list of business and management schools could be compiled from a thorough Google search using such websites as univsource.com, wikipedia.com, allBusinessSchools.com, and so on. On the basis of the identified business and management schools, we used Google search to finally produce a roster of 394 IS undergraduate programs in the United States. These academic institutions all required students to take a set of pre-defined business courses along with either a fixed set of core courses or a set of common

core courses followed by a number of electives in one or more specialization areas to complete the program. Since the purpose of this study is to determine IS core in the United States from the curriculum perspective, we included IS programs both from public and private schools, AACSB-accredited or not.

Using the compiled list of 394 IS programs we performed a content analysis of the websites to identify either their fixed set of core courses or the common core courses as part of their core/elective curriculum structure. Core course data were collected in the period from June to December of 2013. The data items, such as course number, title, and description, were entered into Excel worksheets for the purpose of categorizing, summarizing and ranking. We also developed a Java program to generate analysis results reported in Sections 4.3 and 4.4.

The IS curricula have been widely and effectively used as a standard and comprehensive reference in IS curriculum research. By the time this study was conducted, the IS 2010 was the only model available which offers guidance to both topics in core and electives. Therefore, the course profiling was based on the framework of seven core courses defined in IS 2010. Thus, each collected course was carefully reviewed and, if matched, mapped into one of these seven core courses. Occasionally, multiple courses in an IS program of similar content were mapped into the same IS 2010 core. Further content analysis was performed to categorize those courses that couldn't be mapped into the framework. Finally, statistical analysis was conducted to examine these core courses from three different perspectives: school type, accreditation, and research orientation.

#### 4. RESULTS AND ANALYSES

From the 394 IS programs, we identified a total of 2,229 core courses. The mapping results of these core courses to IS 2010 are reported in Section 4.1. Section 4.2 discusses the courses that couldn't be mapped into any of the seven core courses of IS 2010. Section 4.3 further inspects these mapped courses from three different perspectives – school type, accreditation, and research orientation. Section 4.4 illustrates the distribution of IS programs by the numbers of mapped core courses.

#### Core Courses Mapped into IS 2010

In Table 1 the "Program Count" column refers to the number of programs that offer a course equivalent to (or mapped into) a core course in the IS 2010 model, and the "% of Program" column refers to the percentage out of the total 394 programs.

Among the seven core courses in IS 2010, *Data and Information Management* is the most widely covered course and is offered in 344 (87.3%) out of the 394 programs. The second most covered course is *System Analysis and Design*, which is taught in 314 (79.7%) out of the 394 programs. In total, 1,407 (63.1%) out of the 2,229 identified core courses were mapped into the seven core courses in the IS 2010 model.

IS 2010 Core Course	Program Count	% of Programs
<b>2010.1</b> Fundamentals of IS	247	62.7%
<b>2010.2</b> Data and Information Management	344	87.3%
<b>2010.3</b> Enterprise Architecture	53	13.5%
<b>2010.4</b> IT Infrastructure	127	32.2%
<b>2010.5</b> IS Project Management	261	66.2%
<b>2010.6</b> System Analysis and Design	314	79.7%
<b>2010.7</b> IS Strategy, Management, and Acquisition	61	15.5%

Table 1. Core Courses of 394 IS programs Mapped to the Core in IS 2010

#### Core Courses Not Mapped into IS 2010

There are 822 (36.9% of 2,229) core courses from the 394 IS programs that couldn't not be mapped into any of the IS 2010 core courses. On the basis of their course titles and content descriptions and with our domain knowledge, they were further grouped into other nine categories.

As shown in Table 2, 72.6% of the total 394 programs offer a core course in Programming Language. Application Development (35.8%) and Web Development (26.1%) are ranked as the second and the third. Given their content and nature, these three categories are all programming-related in that they either teach a programming or scripting language or apply a language to develop Windows-based or Web-based applications. Although Application

Development is not in the core of IS 2010, the task force of IS 2010 actually acknowledges that this type of course can still be offered as a core course (Topi et al., 2010).

There are 108 courses, such as Emerging Business Technologies, Computer Tools for Management, and Career Planning in Operations and Information Management, which are very difficult to group into a category with a significant group size. Therefore, they were grouped into the "Others" category.

The percentages of the remaining five categories (i.e., Business Intelligence, E-commerce/Mobile, Senior Project, Cybersecurity, and Business Function Oriented) are relatively low. In the IS 2010 model, they are electives and usually offered because of different preferences in curriculum design or diversity in faculty expertise.

Nine Other Categories	Program Count	% of Programs
Programming Language	286	72.6%
Application Development	141	35.8%
Web Development	103	26.1%
Business Intelligence	53	13.5%
E-commerce/Mobile	43	10.9%
Senior Project	39	9.9%
Cybersecurity	31	7.9%
Business Function Oriented	18	4.6%
Others	108	27.4%

Table 2. Core Courses of 394 IS programs Not Mapped to the Core in IS 2010

### Mapping by School Type, Accreditation, and Research Orientation

As mentioned in Section 3, there are some different core courses in the same program that were mapped into the same core in IS 2010. For each of the 394 IS programs, after excluding the core course(s) which was/were mapped into the same IS 2010 core, the total number of mapped courses is reduced from 1,407 to 1,238. In this and the next sections, we report results on the basis of the 1,238 mapped courses.

We further inspected the 1,238 courses that were mapped into IS 2010 from three different perspectives – school type (i.e., public vs. private), accreditation (i.e., AACSB accredited vs. non-AACSB accredited), and research

orientation (i.e., with a Ph.D. program vs. without a Ph.D. program).

As shown in Table 3, among the 394 programs, 272 (69.0%) are from public schools, while 122 (31.0%) are from private institutes. For the public and private schools, the average numbers of mapped core courses are 3.63 and 3.38 per program, respectively. To see whether there is a statistically significant difference between the two lists of numbers, we ran a t-test and generated a p-value at 0.093. Thus, with a marginal statistical difference, more core courses in public universities were mapped into the core of IS 2010 than those from private institutes.

		Number (% of Programs)	Average number of mapped core course	p-value
School Type	Public	272 (69.0%)	3.63	0.093
	Private	122 (31.0%)	3.38	
Accreditation	AACSB	294 (74.6%)	3.55	0.829
	Not AACSB	100 (25.4%)	3.58	
Research Orientation	With Ph.D. Program	50 (12.7%)	3.50	0.709
	W/O Ph.D. Program	344 (87.3%)	3.57	

Table 3. Mapped Core Courses in Three Perspectives

According to its homepage, <http://www.aacsb.edu/en/accreditation/>, AACSB "provides internationally recognized, specialized accreditation for business and accounting programs at the bachelor's, master's, and doctoral level." AACSB accreditation is regarded as the benchmark for business school quality among the academic community (Burnsed 2011). Among the 394 programs, 294 (74.6%) are from schools that have received AACSB accreditation. In terms of mapping to the IS 2010 core, there is no statistically significant difference (p-value 0.829) between AACSB accredited and Not AACSB accredited schools.

When a school has a Ph.D. program, it can be considered as more research oriented. Since the IS curriculum is the focus of the study, we only look for an IS and IS-related Ph.D. program in a department. Out of the 394 programs we identified a total of 50 which have a relevant Ph.D. program. The analysis shows that there is

no significant difference (p-value 0.709) between schools with a IS or IS-related Ph.D. program (average course mapped at 3.50) and schools without an IS or IS-related Ph.D. program (average course mapped at 3.57).

### Distribution of IS Programs for the Numbers of Mapped Core

We developed a Java program to identify the total number of IS 2010 core courses covered by each of the 394 IS programs. Figure 1 shows the distribution of the numbers of the IS programs and the numbers of IS 2010 core course they offer. Note that the X-axis is not for the seven different IS 2010 core courses; instead, it refers to the total number of the mapped core.

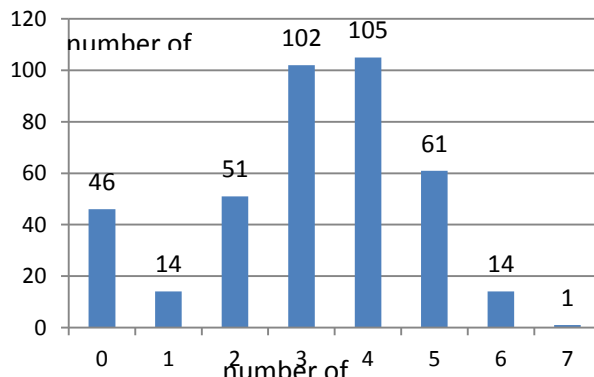


Figure 1. Distribution of IS Programs for the Numbers of Mapped Core

In this distribution, the largest group contains 105 (26.6% of 394) IS programs each of which offers four out of the seven core courses in the IS 2010 model. The second largest group includes 102 (25.9%) programs which provide three of the seven core courses in IS 2010. There are also 46 (11.7%) IS programs not offering any of the IS 2010 core courses and only one (0.3%) program offers all the seven core courses. Only 15 programs offer at least six of the seven core courses in IS 2010.

Overall, the average number of the seven core courses being offered is less than half at 3.14, which indicates that the level of compliance among existing IS programs with IS 2010 is not high. Since the objective of this study is to find the common IS core from the curriculum's perspective, we did not collect any relevant data to explain this gap.

## 5. CONCLUSIONS

This study performed a descriptive analysis of 2,229 core courses offered by 394 undergraduate IS programs in the United States. The result yields a panoramic snapshot of the IS core of the existing IS programs.

The analyses also report how consistent the existing core courses in the 394 IS programs are with those specified in the IS 2010 curriculum model. Among the seven core course, Data and Information Management is the most widely offered course, while Enterprise Architecture is the least covered core course. In total, 1,407 (63.1%) out of the 2,229 core courses have been mapped into the core of IS 2010.

Moreover, the study examined the mapping between the seven core courses defined in IS 2010 and the offered core courses by the 394 programs from three different perspectives, school type (i.e., public vs. private), accreditation (i.e., AACSB accredited vs. not AACSB accredited), and research orientation (i.e., with a Ph.D. program vs. without a Ph.D. program). We find that in terms of the number of mapped core courses of IS 2010, (1) there is no significant difference between schools with or without AACSB accreditation and also between schools with or without a Ph.D. program, and (2) public universities cover marginally more core courses of IS 2010 than private institutions do.

In particular, the study also examined the distribution of the numbers of the IS programs and the numbers of IS 2010 core course they offer. The result shows that about half of the programs offer three or four IS 2010 core courses. There are 46 (11.7%) of the IS programs which do not offer any of the IS 2010 core courses and only one (0.3%) program offers all the seven core courses. The average number of the core courses of IS 2010 being offered is less than half at 3.14. In addition, there are only 15 programs that offer at least six of the seven core courses in IS 2010.

Lastly, for the 822 core courses which were not mapped into the core courses of the IS 2010 model, we developed nine other categories and properly categorized them. We find that Programming Language, Application Development, and Web Development are the top three course categories.

Using the descriptive approach, this study identifies the IS core in the U.S. that is constituted and defined by IS educators who are one of the important organizational stakeholders in IS as a "socially constructed field". From the curriculum perspective, the panoramic snapshot of the IS core presented in this study helps us understand what the existing IS core is. The data also allows us to compare what the IS core is with what it is recommended to be by using the seven core course framework of IS 2010. We believe that the findings of the study are valuable to all IS stakeholders, such as IS scholars, IS educators, and the practitioners, who are responsible for or interested in IS core design and development.

The IS 2010 curriculum model was used only for its utility as a reference, not its currency and practicality, in this study. One of the future research directions is to study the gap between the core courses being offered in schools and those prescribed in IS 2010. Another possible future study is to examine the relationship between the knowledge and skills taught through the IS core curriculum and those demanded by the industry in order to optimize the IS curriculum to better serve students.

## 6. REFERENCES

- Apigian, C.H. & Gambill, S.E. (2010). Are We Teaching the IS 2009 Model Curriculum? *Journal of Information Systems Education*, 21(4), 411-420.
- Benbasat, I. & Zmud, R. W. (2003). The Identity Crisis Within the IS Discipline: Defining and Communicating the Discipline's Core Properties. *MIS Quarterly*, 27(2), 183-194.
- Burnsed, B. (2011). Top M.B.A. Programs Embrace Online Education. *U.S. News & World Report*. Retrieved May 16, 2013 from <http://www.usnews.com/education/online-education/articles/2011/03/15/top-mba-programs-embrace-online-education>.
- Bell, C., Mills, R., & Fadel, K. (2013), An Analysis of Undergraduate Information Systems Curricula: Adoption of the IS 2010 Curriculum Guidelines. *Communications of the Association for Information Systems*: 32, Article 2, 73-94.
- Davis, G.B., J.T. Gorgone, J.D. Couger, D.L. Feinstein, & Longenecker, H.E. Jr. (1997). IS '97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. *The DATA BASE for Advances in Information Systems*, (26)1, 1-94.
- Golden, D. & Matos, V. (2006). Introducing the Unified Modeling Language into the Information Systems Curriculum. *Journal of Information Systems Education*, 17(1), 83-92.
- Gorgone, J.T., Davis, G.B., Valacich, J.S., Topi, H., Feinstein, D.L. & Longenecker, H.E. Jr. (2002). IS 2002 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. *The DATA BASE for Advances in Information Systems*, (34)1, 1-53.
- Helfert, M. (2011). Characteristics of Information Systems and Business Informatics Study Programs. *Informatics in Education*, 10(1), 13-36
- Hwang, D. & Curl, S. (2013). The Market for Career Tracks in Undergraduate IS Curricula in the U.S. *Information Systems Education Journal*, 12(3), 4-17.
- Jones, M. R. (1997). It All Depends What You Mean by Discipline. in *Information Systems: An Emerging Discipline?* Mingers, J. and Stowell, F. (eds.), McGraw-Hill, London.
- Kim, I. & Kuljis, J. (2010). Applying Content Analysis to Web-based Content. *Journal of Computing and Information Technology*, 18(4), 369-375.
- Kohun, F.G., Rodi, A.F., & DeLorenzo, G.J. (2012). Does Information Systems Suffer An Identity Crisis? A Case Study of Confusion and Misinformation. *Issues in Information Systems*, 13(2), 328-335.
- Kung, M. Yang, S.C., & Zhang, Y. (2006). The Changing Information Systems (IS) Curriculum: A Survey of Undergraduate Programs in the United States. *Journal of Education for Business*, (81)6, 291-300.
- Lifer, J.D., Parsons, K, & Miller, R.E. (2009). A Comparison of Information Systems Programs at AACSB and ACBSP Schools in Relation to IS 2002 Model Curricula. *Journal of Information Systems Education*, (20)4, 469-476.
- Lim, J., Rong, G., & Grover, V. (2007). An Inductive Approach to Documenting the "Core" and Evolution of the IS Field.

- Communications of the Association for Information Systems*, 19, Article 32.
- Longenecker, B., Feinstein, D., & Clark, J. D. (2013). Information Systems Curricula: A Fifty Year Journey. *Information Systems Education Journal*, 11(6), 71-95.
- Maier, J. L., Clark, W.J., & Remington, W.S. Jr. (1998). A Longitudinal Study of the Management Information Systems (MIS) Job Market. *Journal of Computer Information Systems*, 39(1), 37-42.
- Maier, J. L. & Gambill, S. (1996). CIS/MIS Curriculums in AACSB-Accredited Colleges of Business. *Journal of Education for Business*. 71(6), 329-333.
- Moshkovich, H., Mechitov, A. & Olson, D. (2005). Infusion of Electronic Commerce Into the Information Systems Curriculum. *The Journal of Computer Information Systems*, 46(1), 1-8.
- Porter, J. & Gambill, S. (2003). Information Systems Curricula 2003. *The Review of Business Information Systems*, 8(4), 33-40.
- Sidorova A, Evangelopoulos, N., Valacich, J.S., & Ramakrishnan, T. (2008). Uncovering the intellectual core of the information systems discipline. *MIS Quarterly*, 32(3), 467-482.
- Stefanidis, A. and Fitzgerald, G. (2010). Mapping the Information Systems Curricula in UK Universities. *Journal of Information Systems Education*, 21(4), 391-409.
- Topi, H., Valachic, J.S., Wright, R.T., K. Kaiser, Nunamaker, J.F. Jr., Sipior, J.C., & de Vreede, G.J. (2010). IS 2010: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems. *Communications of the Association for Information Systems*, 26(18), 359-428.