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Is There a Need For a Computer Information Systems Model Curriculum?

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Abstract

Model Curricula for Information Systems for the last 50 years (Longenecker, Feinstein and Clark, 2013) have used the designation "Information Systems" as if it were a "pure" species while essentially ignoring and/or subsuming designations such as Computer Information Systems (CIS) or Management Information Systems (MIS). However, it is generally recognized that programs of CIS are usually more technical. Perhaps, as it stands, the current IS2010 model does not adequately recognize the depth required for these more technical programs though its assumption that by adding a few programming courses the essence of these variants will be addressed. We looked at existing survey data from the government and current academic surveys of industry to explore their expectations. The results suggest that considerably more technical focus as well as depth of learning may well be required to meet the needs of the professional community befitting of the Computer Information Systems (CIS) designation. We propose that an extension of the IS 2010 model be developed to embrace these findings. This curriculum will be referred to as CIS. The goal of this curriculum model is to ensure that its graduates are prepared for the current technical job market that is part of the approximately one-half million jobs in Science, Technology, Engineering and Mathematics (STEM) jobs that are anticipated by the department of labor over the next decade. Computer Information Systems is composite discipline focusing on both the practical objectives of organizational and people skills and the technological expertise needed by many of today's organizations.

1 THE MISSION OF INFORMATION SYSTEMS

The Computer Information Systems profession is unique in that it must concentrate on both organizational issues simultaneously with technical issues of computing. Indeed McNurlin and Sprague (2006) express that the integrative mission of information systems must be to assure that individuals will be able to complete their goals (with respect to organizations) through the application of the computing technologies. The net result will be an increase

in organizational productivity. Computing technologies enable business and organizational systems that will drive the world's economies for decades to come. Academia must also maintain an acute awareness of the importance of preparing graduates for a world that is rife with security breaches of an ever increasing ominous nature. Because of the extreme competiveness among organizations and between nations we will be forced to require shorter development cycles with ever more trustworthy applications.

Our students must develop confidence in their abilities to thrive in this complex information society. As they enter the work-force they must integrate their computing skills along with the traditional information systems knowledge and interpersonal abilities. The importance of individuals and their participation in the process of design (Babb and Waguespack, 2013) and implementation (Babb et al., 2013; Reinicke and Janicki, 2010) will continue to rely on the successful conceptualization of information systems within organizations (Barki and Hartwick, 1989; Hunton and Beeler. 1997; and Markus, 1983).

2 RESPONSIBILITIES OF THE MODEL CURRICULUM

We propose that a task force be developed for the implementation of a CIS Curriculum as an extension to the IS 2010 model curriculum (Topi, et al, 2010). This paper explores issues and rationale for the advancement of the distinction of a CIS curriculum model. At this time, Table 3 identifies programs that explicitly use the name of CIS. In general, developers of a CIS Model Curricula will have the responsibility of leading the discussion among the academic and organizational leaders to determine the attributes of the graduates of the CIS programs. The next task will be to determine the individual components that will transform the students entering the program to graduates with the ability to combine computing technologies, information systems design concepts, and organizational and interpersonal skills. Then, the curriculum designers must take each component and determine the sequence in the curriculum for that component and the appropriate level of mastery to aim for during the course of curriculum delivery. An initial conceptualization of these curricular specifications would include: designing new systems based on prescient and directed interaction with people and organizations; tacit utilization of systems design principles; programming and application development with awareness of distributed data; and deployment/management in a secure manner. As an extension to IS 2010, a CIS model curriculum would explicitly require programming as an actionable skill to facilitate data and systems design and development.

Another important outcome of this process is to discuss possible delivery models including the constraints of the traditional course and semester structure which assumes a target 120 credit hours for an undergraduate degree in CIS.

3 USERS OF THE MODEL CURRICULUM

Feinstein, Longenecker and Shresta (2013) have shown a specific constituency for the CIS curriculum. While Table 3 identifies over 100 current programs, it is quite probable that the number of institutions that could benefit from this model is much larger. The potential number of programs relevant to the model could be extended further by including both the variety and specialization made possible by options or tracks. However, the presence of tracks should not detract from the essential core curricular concerns which stand to specify the area of the computing spectrum which CIS is located.

A basic assumption for this approach holds that a "core + electives" structure leads to a meaningful course of study. While this is a tidy and idealistic abstraction convenient for curriculum designers, our true aim is to provide a basis for a curriculum design which provides a program with an opportunity to produce candidates qualified for entry level jobs. Thus, the flexibility to design a curriculum which suits local needs, which is an inherent part of IS 2010, is appropriated here to proffer a CIS curriculum designed to produce student outcomes which lead to employability in the field.

Consistent with the mission of Information Systems, we detect at least three distinct paths for which a curriculum can serve the information systems profession: 1) Information Systems Design; 2) Information Systems Management; and 3) Information Systems Applications Development and Deployment. While there is considerable skills overlap between these, the depth of skills in these areas is not equivalent as job demands are also dissimilar. Generally, the application developer will require considerable depth in more technical skills.

Earlier curriculum products have utilized predominantly the one-size-fits-all model of IS'97 (Couger, 1997; Davis, 1997) and IS 2002 (Gorgone, 2003). This issue led to changes that have resulted in the approach taken in IS 2010.

While it is possible to debate whether Computer Science graduates would be better suited to application development whereas Computer Information Systems students would be better designers and managers, there is undeniably a place for both graduates in all facets. However, a core distinction would be necessary to substantiate the need for a CIS curriculum. Given our previous characterization of the possible paths for information systems, we foresee that a CIS curriculum would focus more in issues of design and application development, but not to the total exclusion of information systems management issues.

4 INFORMATION SYSTEMS 2010

There are some practical advantages of the IS2010 Model Curriculum (Topi, 2010). With a seven-course core and multiple electives, a modicum of flexibility is afforded. In this model, the core is essentially flat and elective courses are meant for tailoring depth and specific knowledge to taste.

However, this strength is also IS2010's weakness. There exists an identity crisis among programs commonly known as information systems such that our collective brand is quite diluted and generally suffers for it (Babb and Abdullat, 2013). Being known under a wide range of moniker may afford flexibility to suit local characteristics and proclivities, but it may be ill-suited to the prosperity of the discipline. It may then seem contrary to call for fewer nomenclatures in a paper arguing in favor of a CIS model curriculum. However, acknowledging CIS as a more technical end of our spectrum, may allow programs to coalesce about MIS or CIS. As we grapple with enrollments, changing demands in the technology landscape, and evolving modes of education delivery, a reduction in nomenclature may allow an opportunity to stake a rightful claim in the spectrum of computing (Shackleford, 2006).

It is worth noting that most of the accredited programs of information systems offer all of the IS 2010 core except the enterprise architecture course. They also offer from one to four programming courses, operating systems, and a telecommunications and networking course. (Feinstein, et al, 2013; Larson, 2012)

IS 2010 has a larger emphasis on security than IS 2002. IS2010 also introduces enterprise architecture, and risk management concepts. Security has become increasingly important in commerce within government enterprises throughout the world. Security issues dominate many of the concerns of the world governments. In the United States, the government has helped organize the Committee on National Security Systems (CNSS) as well as the National Security Agency (NSA). The Committee on National Security Systems has developed a set of standards for training information Systems Security Professionals.

Later CNSS developed a standard for National Information Assurance Standards for Senior Systems Managers (see Subramanian, 2010). The creation National Information Assurance Education and Training Programs were done during the Clinton and Bush Administrations. (See Subramaniam, 2010) Subsequently, a set of standards was developed to recognize institutions that develop a program in Information assurance. These institutions are recognized as a Center of Academic Excellence in security education. (Subramanian, 2010).

5 EVALUATION OF EMPLOYER DEMAND

Curriculum designers have an obligation to develop course sequences that will enable students to gain an appropriate depth of knowledge suitable for a transition into a productive career. This should be captured within curricula model and refined by academic units working with their industrial advisory boards. The US Department of Labor has retained subject matter experts to conduct job analysis of various fields related to CIS. This data is useful in establishing the current needs for CIS professionals. The Department of Labor projections are useful through 2020 (see DOL1, DOL2, DOL3 and DOL4, 2010). For the Science Technology Engineering and Mathematics (STEM) which include the professions found in the Table 1 below. The estimate is for 500,000 new jobs for this period. Code.Org which represents many of the leading IT organizations states there is a need for 1,000,000 professionals. It is safe to say many of these professionals will be our present and future students. While we have little doubt that these students will share in the job growth related to

the need for application development, we must carefully avoid the "gold rush" mentality that has pervaded our past and present behaviors if not our espoused theories on curriculum development. To wit, we call for a reconciliation of what computer information systems may mean within the spectrum of computing opportunities. With a blend of organizational competencies, design acumen, and technical abilities to shape data and information with the application of computer programming, what will distinguish our graduates? We must look beyond participation in the latest gold rush and develop an identity to promulgate demand for the essence of our product. In this sense, we need to shape our profession so that employers value our unique qualities along with our common qualities.

Table 1 consists of an "employer-view" of relative importance of various IT skills. Data shown in this table has been converted to a 0-100 scale (100 highly important—0 not important). Categories were based on abstracted categories of the data provided by Aasheim (2012). Colvin (2008) (column 1) surveyed graduates after several years in the work-place. Four Department of Labor (DOL1, DOL2, DOL3, and DOL4 - columns 2-5) STEM jobs match closely to jobs usually filled by IS graduates (Computer Systems Analyst, Software/Applications Developer, Data analyst/DBA, and Web Developer). Aasheim (2012) (column 6) surveyed both senior managers and IT workers. Computer World's 10 Hot IT Skills (column 7) are shown as percentage of the estimated 2013 new hires for the work place. Column 8 is an average of the preceding columns. In sense we can see how our graduates can fulfill several common areas which may also filled by graduates from other computing disciplines.

Several quotes from the Computer World (Pratt, 2012) further clarify the need for a computer information systems student's common skills:

> *"When you look at Technology, it drives so much of what business does, from productivity to communications to improving speed to making better decisions. So companies are investing in that, and you have to have the people experienced in doing that."*
>
> *"Technology and software are great ways to improve productivity, lower costs, and better web presence."*
>
> *"…our top need is programming… to meet the business need."*
>
> *"…the company expects to continue building its IT security team from the top down… professionals who have business acumen (are needed)…"*

Because of the severe shortage of competently educated IT professionals, many of the jobs that are filled are filled by insufficiently trained people.

> *There is little question that "…IS programs must lead to the integration of technical capabilities and domain of practice (such as business) capabilities, nobody else offers these combinations, and it is* ***the integrative combination of skills that truly adds value****…" Also, it is equivalently clear that employers expect very strong personal, interpersonal and organizational skills. These skills rank considerably higher that the technological skills. Yet, one suspects that without the technology skills, there would be no hiring…* (H. Topi, 2013)

Thus, we have demand for common computing skills, but also a compelling case for the unique blend that could identify the nature of a CIS curriculum. Our anticipation of demand for these competencies must extend beyond our normal "gold rush" response and into the realm of an exact account of our identity. One means of stating the unique identity of CIS is to develop a model of its curriculum.

6 IMPLICATIONS FOR CIS CURRICULUM DEVELOPMENT

The levels of skill expectations suggest that both computing technologies and people skills are of significant importance to employers. If our students are to be successful they will be able to integrate technologies into the domain of practice (business, nursing, government, education …). It is clear they must learn the technologies before they can integrate them. The technologies that students must acquire include telecommunications and networking, operating systems, database, systems analysis, applications development, security and information assurance, and project management.

Most colleges and universities require that total credit hours approaching 120 hours. These

hours also include a university core curriculum of required subject matter in the sciences, fine and performing arts, humanities, social sciences, and the physical and life sciences. As a CIS curriculum extends beyond these basic topics, we must carefully craft appropriate coverage of CIS topics in the remaining space. In more advanced courses our students should be required engage in practice that results in the integration of technical knowledge with interpersonal skills and organizational expertise acquired in earlier course work. While we will design an educational process that aims towards mastery, the relative immaturity of the students requires expectations management and a reliance on our industry partners to "finish" the job. However, this journey is best facilitated through the design of student outcomes should require that students learn and practice the supporting personal, interpersonal, and organizational skills throughout the curriculum. To do so would continue to distinguish our profession in a manner that our brand both recognizable and in demand.

7 PROPOSED ADDITION TO IS2010

Figure 1 illustrates an initial proposed model curriculum for CIS. This CIS curriculum uses six of the seven courses from IS 2010. The proposed CIS model curriculum requires twelve courses, two of which are electives. The Model adds a three-course application development sequence strengthened (see Babb, e.al, 2013) through the integration of database technology. A two-course sequence in operating systems and networking enables addition of security into these courses. This sequence enables introduction of hands-on lab experiences. Based on inspection of accredited IS programs, IS 2010.3 Enterprise Architecture is reconsidered as an elective.

By taking electives related to Information Assurance, it is possible to attain certification in Information Assurance depending on the selection of electives (Subramanian,et al, 2010). By taking the electives related to health informatics it is also possible to attain a Health Informatics certification (Longenecker, Campbell, Landry, Pardue and Daigle, 2011).

Our recommendation for a general path through the proposed CIS model would be a choice of elective involving the capstone approach—a two course sequence in Business Information Systems Development. (Reinicki and Janicki, 2010).

Table 2 below provides a sketch which suggests the relationship between IS 2010 and this new CIS model curriculum.

8 NEXT STEPS

From our discussion above, it has been suggested that there gaps specification of technical rigor in IS2010 (Longenecker, Feinstein & Clark, et al, 2013; Feinstein, Longenecker, Shrestha, 2013). We also feel that it is necessary to achieve sufficient depth in several important enumerated areas within Table 1. These include people skills, and technology skills (systems analysis and design project management, programming, operating systems and telecommunication, data management, and information security assurance and management). The curriculum plan expressed in Figure 1 will provide the guidance to achieve necessary depth.

It is our recommendation that IS 2010 be "extended" to include the CIS model proposed. It would then be necessary find professional organizations interested in sponsoring this effort. We offer this as a call to heed this task in order to better define the distinctions that positively characterize CIS.

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Appendix

Table 1: Expected Competencies of IS Graduates

Categories	**Survey**	**Department of Labor Future Needs**				**Survey**	**Computer World**	**Average Skill**
	1	2	3	4	5	6	7	8
Competency Level (0-100)	**Recent IS Grads** **Colvin 2008**	**Sys Analyst**	**DBA DA**	**App Develop**	**Web Develop**	**IT Prof.** **Aasheim 2012**	**Hot Skills 2013 (% of new Jobs) Pratt 2012**	
Personal Characteristics	80	65	61	61	68	80		69
Interpersonal Skills	90	69	55	55	57	79		68
Organizational Skills	91	76	64	72	66	71		73
Technology (Average)	77	75	75	79	67	71		74
IT Alignment	79	65	61	72	65	72		69
Networking	65	71	84	82	60	69	19% networking	72
Operating Systems	69	82	74	91	77	72	27% Security 19% virt	78
Database/BI	74	86	76	81	66	70	26% DB/BI	76
Sys Analysis and Design	82	67	68	74	68	77		73
Programming	76	89	89	84	71	74	60% Pgm. 19% MobileDev.	81
Project Management	91	63	76	69	66	66	40% Proj. Mgt	72

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Figure 1: Proposed CIS Program

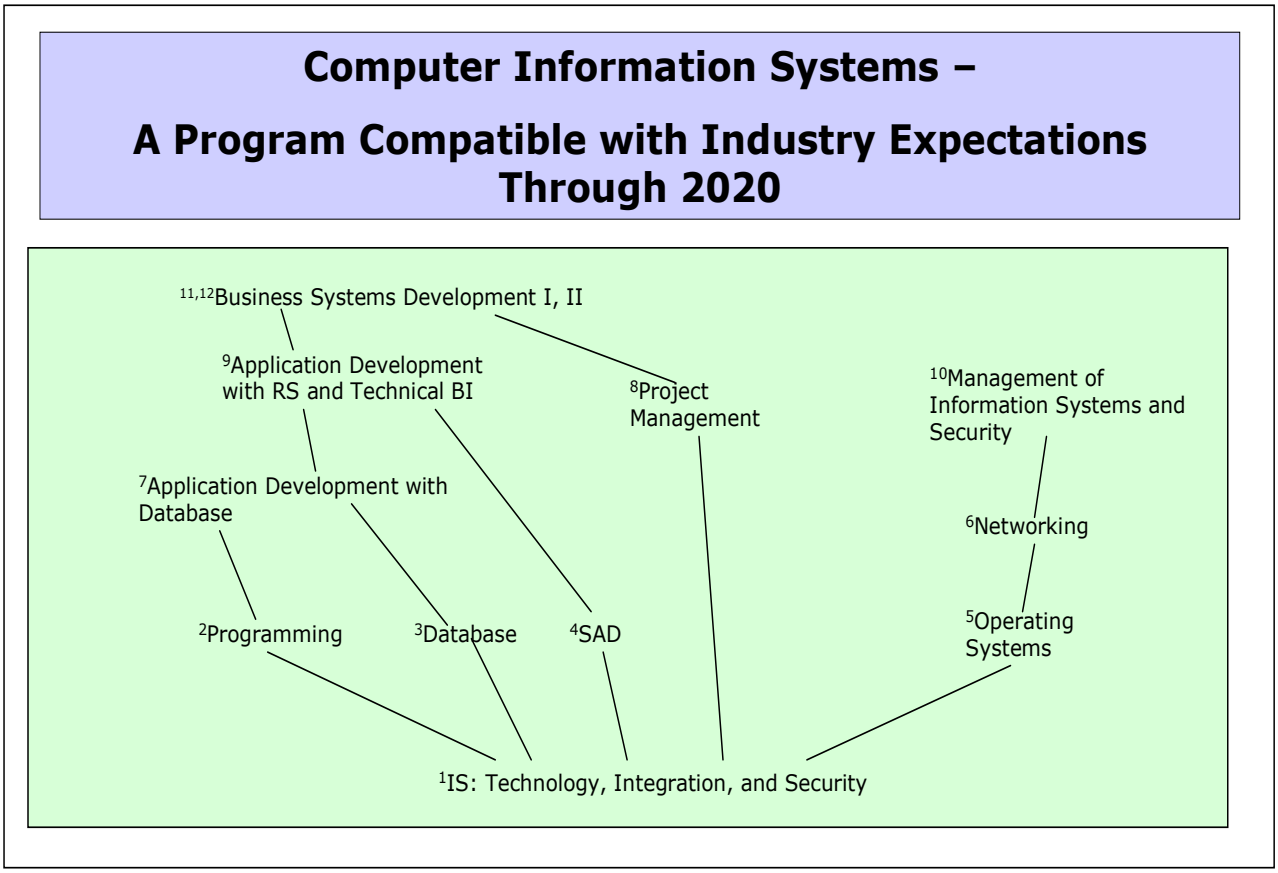

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Table 2. Comparison of IS 2010 and Proposed CIS Model

Proposed CIS Model Curriculum	**IS 2010**
1. IS: Technology, Integration, and Security	IS 2010.1 Foundations of Information Systems
2. Programming	New
3. Database	IS 2010.2 Data and Information Management
4. Systems Analysis and Design	IS 2010.6 Systems Analysis and Design
5. Operating Systems	IS 2010.5 IT Infrastructure
6. Networking	
7. Application Development with DB	New
8. Project Management	IS 2010.4 IS Project Management
9. Application Development with RS and Technical BI	New
10. Management of IS and Security	IS 2010.7 IS Strategy, Management and Acquisition
11. Elective 1	
12. Elective 2	
Electives (choose 1 category)	
Capstone Course: Business Information Systems Development Business Systems Development I Business Systems DevelopmentII	 New New
Health Informatics HI Decision Support HI Systems Analysis, Design, Implementation	New
Advanced Data Management (choose 2) Data Mining Data Warehousing Analytics	 New New New
Enterprise Systems Enterprise Architecture ERP	 IS 2010.3 Enterprise Architecture Enterprise Systems
Security (choose 2) IT Security and Risk Management IT Audit and Controls Management of Information Assurance & Security Digital Forensics	 IT Security and Risk Management IT Audit and Controls New New

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Table 3. Computer Information System Programs (Wikipedia (2013)

Appalachian State University
Arizona State University
Addis Ababa University Ethiopia
Adeleke University
Africa University
Alabama State University
Arkansas Tech University
Ashford University
Australian Catholic University
Babcock University
Ball State University
Baruch College
Benedictine University
Bentley University
Bethune-Cookman University
Brigham Young University
Buffalo State College
Al-Balqa` Applied University
California Lutheran University
California State Polytechnic University, Pomona
California State University Bakersfield
California State University Chico
California State University Los Angeles
California State University Stanislaus
California University of Pennsylvania
Cedar Crest College
Chapman University
Clemson University
Cleveland Institute of Electronics (CIE)
Coleman University
College of Charleston
Colorado State University
Colorado State University-Pueblo
Columbia College (Missouri)
Davenport University
Delta State University
Devry University
Drury University
Eastern Kentucky University
Eastern Washington University
Everest University
Ferris State University
Fisher College
Frostburg State University
Florida Institute of Technology
Florida Gulf Coast University
Georgia State University
Greenville College
Idaho State University
Illinois Institute of Technology
Inoorero University{kenya}
James Madison University
Lund University
Kennesaw State University
MARA University of Technology
Mayville State University
McKendree University
Missouri State University
Missouri Western State University
Mount Royal University
Murray State University
Near East University
Northern Arizona University
Northern Michigan University
Oxford Brookes University
Payap University
Pfeiffer University
Pokhara University
Quinnipiac University
Radford University
Regis University
Roosevelt College System Philippines
Saint Leo University
Siena Heights University
Singapore Management University
Slippery Rock University of Pennsylvania
Sofia University[46]
Stanford University[47]

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St Francis Xavier University
Stephen F. Austin State University
Stetson University
SUNY Fredonia
SUNY Cobleskill
SUNY Institute of Technology
Texas State University–San Marcos
The Wescoe School of Muhlenberg College Muhlenberg College
Trinity College Dublin
Troy University
University of Akron
University of California, Irvine
University of Central Missouri
University of Colombo
University of Florida
University of Georgia
University of Houston
University of Houston–Clear Lake
University of Houston–Victoria
University of Idaho
University of Jordan
University of Lincoln
University of Liverpool
University of Louisville
University of Lund[
University of Maine at Augusta
University of Malta
University of Mary Washington
University of Miami
University of North Dakota
University of North Texas
University of Oklahoma
University of Puerto Rico
University of South Alabama
University of South Carolina Upstate
University of Technology, Jamaica
University of Texas at El Paso
University of the Incarnate Word
University of Wisconsin - Stevens Point
Valley City State University
Western Carolina University
Western Michigan University
Yarmouk University
Guru Gobind Singh Indraprastha University
Guru Gobind Singh Indraprastha University
University Of Sabaragamuwa
University of Botswana