Constructing a Workable Computer Information Science/Computer Science Curriculum: A Template for Developing a Cross-Discipline Model

William Burkett
Rinker School of Business, Palm Beach Atlantic College
West Palm Beach, FL, USA

burkettw@pbac.edu

Executive Summary

There is a constant demand for knowledgeable and computer literate undergraduates, according to recently published surveys. This paper describes an 8-step template, used to create an updated curriculum for a computer information sciences department at a small liberal arts college.

Industry is constantly hiring individuals that can install a network, maintain an Internet web site, enhance software applications, competently oversee the upgrading of entire systems and much more. All of these areas rely on varying degrees of computer-based training. IS/IT/CIS graduates must be competent in these areas (to name a few) if they are to succeed in their chosen careers.

The 8-step template was created during the early phases of studying the present curriculum. The 8-step template includes: (1) Establishing the exact nature of curriculum problems, (2) Prioritizing and accessing needs, (3) Projecting a long range curriculum plan, (4) Consulting parallel accredited schools catalogs for similar programs, (5) Adapting national and international model curriculums, (6) Involving academic and industry leaders in curriculum development, (7) Including elements of Felders "active learning" in the curriculum plans, and (8) Developing a workable timetable for implementation.

During the initial stages of the development of the 8-step template it was determined that a consistent system of prerequisites were needed to reduce the excessive amount of redundant teaching. Secondly, the curriculum needed to have an assured amount of freedom built-in to it to enable it to react to the constantly changing faces of computer science. Third, the reworked curriculum would need to follow recognized model curriculums to remain viable in academia, both within the school of business and as part of the standards set by the national accrediting board of the college. To find an answer to this complex need, the curriculum models of the CSAC/CSAB, ISCC, ACM/AIS/AITP, OEIS, IEEE-CS/ACM, and IRMA/DAMA were considered, as well as the in-place curriculums of over 40 similar type and size colleges. Additionally conversations with local and national industry leaders, professors in courses that impact IS/IT/CIS students (such as math, business administration, and arts and sciences), textbook manufacturers, and many others were made a part of the body of research material.

The final curriculum product contains a positive path of prerequisites that in turn reduce redundant teaching and speeds the student towards graduation. This is accomplished, in part, by reducing loss of time for the student, due to taking courses out of sequence. Secondly, the new curriculum is designed to be responsive to changes in the shifting computer industry. Third, the curriculum is consistent with curriculum models, comparable

schools of computer information sciences, as well as the appropriate accrediting agencies.

The final product is one that is responsive to the long-term needs of the students, the school, and the computer industry. The 8-step template is akin to a landing checklist for a pilot. The template will not guarantee success, but it will point the department in the right direction, by ensuring that all relevant areas are efficiently covered.

Keywords: Computer Science (CS), curriculum, Information Technology (IT), Information Science (IS)

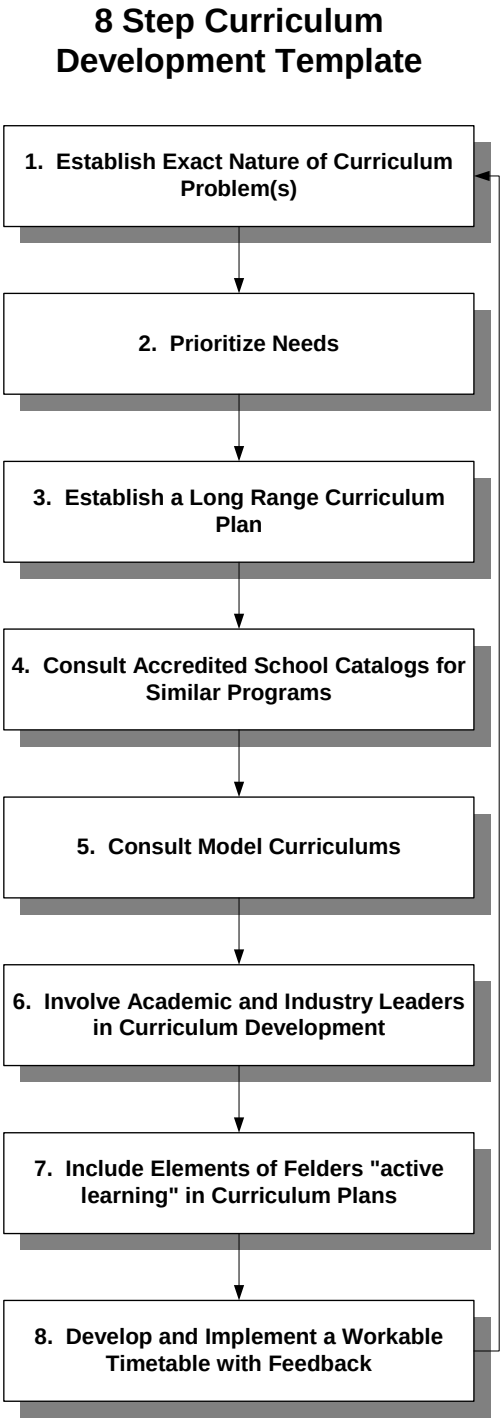

Figure 1: Eight Step Template

Introduction

According to recent published surveys, there is a constant demand for knowledgeable and computer literate undergraduates. Is it the obligation of academia to teach students both in the rigors of subjective and objective arenas of study? Should they be taught to not only use their heads, but also their hands? Should we as educators develop our curriculums to incorporate market driven subjects? These and other questions were the driving force in a recent case study of the curriculum of the Computer Information Systems department at Palm Beach Atlantic College.

It is a fact that industry is hiring individuals that can install a network, maintain an Internet web site, enhance software applications, competently oversee the upgrading of entire systems and much more. All of these areas use varying amounts of training and Computer Science graduates must be competent in both if they are to succeed. This was reiterated recently in the Occupational Outlook Handbook, published by the U.S. Department of Labor's Bureau of Labor Statistics. According to the 2001-2 edition “Technological advancements will increase the employment of computer-related workers; as a result, the demand for managers to direct these workers also will increase.” This is not to imply that schools must be market driven, but they must be market savvy to be competitive in current academic markets. An excellent resource on the changing demands for IS/IT in Europe is “Assessing the Supply and Demand for Scientists and Technologists in Europe”, 2001, Pearson R, Jagger N, Connor H, Perryman S (IES) with de Grip A, Marey P, Corver F (ROA). A parallel paper “The Supply of Technology Workers in the United States”, 1999, by Peter Freeman and William Aspray is a study of the changing needs for IS/IT workers in the U.S.

Richard Felder (1995) talks of an “active learning” environment as being a combination of hearing and doing. Many in academia frown upon this approach. Maybe it smacks of a technical school? According to Felder’s paper on “Active Leaning: Who Said It Was Easy?” Chemi-

Chemical Engineering Education (1995) 29 (1): 32-33, he commented that students learn more by doing than by listening.

Mehic and Al-Soufi (1999) successfully developed a program that incorporated admirable academic standards and included "… cooperation with industry firms" in order that students could "… take advantage of opportunities, gain experience, and make an impact immediately" on industry.

If the colleges under study were an indicator, Colleges are increasingly incorporating industry needs into their curriculum. The nature of the CIS/CS disciplines seem to demand that they also incorporate industry needs into their curriculum. At no time does this diminish the need to teach students logical thought, and subjective / objective analysis. This case study follows the path taken by the PBAC CIS department as decisions were made using these fundamental concepts. An 8-step curriculum solution template was developed (see Figure 1). In essence this was accomplished by:

1) Determining where the CIS department was as of the date of the study, including type and number of staff, student major and minor needs and expectations, and what forces drove it to this point (CIS Department at PBAC),
2) Determining what curriculum standards were currently acknowledged by major college CIS departments (including incorporating the major divisions of recognized Management Information Systems textbooks), and were apropos to a CIS department in a small college serving an international student body (Curriculum Standards Considered),
3) Pinpointing major areas of concern, that could be addressed in a reasonable time period, without major disruption to students currently in the program (The Problem), and
4) Putting into place a curriculum revision plan (Post-Study Solution) involving:
    a) The introduction of a system of pre-requisites,
    b) A multi-track plan of student study within curriculum guidelines, and
    c) A reasonable timeline of implementation.

State of the CIS Department at PBAC

Typical of many countries and regions of the world, small colleges and universities make up a sizeable portion of the accessible advanced learning available to students who desire or require a higher education. In addition these colleges face many of the same problems, such as inadequate resources, students needing specific areas of learning, a constantly changing and evolving discipline, need for implementation of standards in curriculum, and local and national academic and industry requirements. Palm Beach Atlantic College (PBAC) is just such a typical small (2000+) Southern Association of Colleges and Schools (SACS) accredited private liberal arts college situated in southeastern Florida. The classic student is required to have acquired a minimum of 120 semester hours in order to apply for graduation. The Computer Information Systems (CIS) Department is a part of the Rinker School of Business (RSB) of PBAC and normally oversees between 50 - 65 Majors and 20-25 Minors in the undergraduate program (a third of which are foreign nationals). The CIS faculty includes two full time professors, and adjuncts as needed. All cataloged courses are offered at least once a year on a rotational basis, with new courses typically offered as experimental courses during the summer term, one year before possible inclusion in the standard curriculum. PBAC offers only a CIS Generalist major, being a moderately sized college with limited facilities and faculty.

CIS students at PBAC are representative of many colleges and universities, in that they must fulfill various degree requirements, in addition to their computer courses. The CIS department at PBAC is a division of the Rinker School of Business and, therefore, the CIS majors have more than computer science requirements to fulfill. Students typically amass 3-4 semester hours of credit for each class they success-

fully undertake. At PBAC, the B.Sc. requirements include 32 semester hours of business, 11 hours of upper-level electives, and 43 hours of Unified Studies (General requirements) plus the 35 hours of their Major – totaling 121 semester hours.

Businesses are vying for computer literate workers, in addition to the academic rigors placed on students. As a result, CIS majors in their Junior/Senior year are typically recruited for significant positions in industry.

The CIS Department, at PBAC, had undergone a continual turnover in both leadership and direction over the past 8-10 years. Each department chair/professor had, apparently, pressed for changes in the CIS curriculum to meet or enhance their strengths or interests; therefore, the curriculum was a hodge-podge of ideas and directions. This problem was further evidenced by the lack of a coherent set of pre-requisites on the majority of CIS courses and a plethora of students without concrete graduation plans in place.

In conference with the Dean of RSB, it was decided to make a study of the CIS curriculum both objectively and subjectively. The long-term goal of the study was to develop an updated and realistic curriculum adhering, as closely as possible, to published national computer science curriculum standards, PBAC academic requirements, like college computer departments, and industry/market-driven needs.

Curriculum Standards Considered

There are, at present, a great many Information Science (IS) / Computer Science (CS) curriculum standards that can be used as guideposts. It was decided to study both curriculum fields due to the duality of the Computer Information Systems (CIS) discipline established at PBAC. Both IS intensive and CS intensive models were included as none could be found that effectively met the needs of PBAC's hybrid degree. A short portion of each model is extrapolated to provide a sense of the overall body of work and the current URL of each accrediting agency is included in the Appendix.

Computer Science Accreditation Commission (CSAC) of the Computing Sciences Accreditation Board (CSAB), January 2000

According to the Computer Science Accreditation Commission (CSAC) of the Computing Sciences Accreditation Board (CSAB), January 2000:

> In order to be considered for accreditation a computer science program must be designed to give graduates a broad general education at the baccalaureate level and to enable them to function effectively in the computer science profession. Programs designed to prepare graduates for supporting roles in computer science, e.g. technician, are not eligible, nor are programs that fail to provide an adequate base for the application of concepts fundamental to the discipline of computer science.

The CSAC/CSAB model appears to be designed for a computer science major, possibly going on to their Masters. It calls for "40 hours in computer topics … 30 hours in math and science … (and) … at least 30 hours in humanities, social sciences, arts and other disciplines …"

Information Systems-Centric Curriculum '99

The Information Systems-Centric Curriculum (ISCC) '99 guide directed toward IS academic departments stated that:

> This curriculum prepares graduates to work in teams with process owners and users. It prepares graduates to identify information systems solutions to large problems, and communicate with others. The graduate of the curriculum will decompose problems, develop alternative solutions, evaluate alternatives, conceptualize designs, build, test, validate, and deliver large or complex in-

> formation systems in a team environment. Graduates also will understand the social implications of their actions.

This curriculum spoke often of student-team based learning in large mainframe environments.

IS '97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems

The IS '97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems as developed jointly by the Association of Computing Machinery (ACM), Association of Information Systems (AIS), and the Association of Information Technology Professionals (AITP), in their Conclusion said in part that:

> Graduates of IRM/MIS programs must now have more than merely a command of more than a few programming languages. They must understand the role of information resources in organizations and how to manage these resources effectively.

The IS '97 Model also noted that:

> … we need to offer them (students) courses that deal with emerging technologies, applications, and programs using graphics, database strategies, and decision support systems rather than strictly programming languages.

In 'The Scope of Information Systems', it is stated that:

> Information Systems, as an academic field, encompasses two broad areas: (1) acquisition, deployment, and management of information technology resources and services (the information systems function) and (2) development and evolution of infrastructure and systems for use in organization processes (system development).

The IS '97 was not used in total because it dealt rigidly with an IS degree leaving little leeway for inclusion of CS subjects such as programming and operating systems. It is definitely management oriented and specifies that students have practical knowledge of development tools. This is not bad; it just was not what was needed in this situation.

Organizational and End-user Information Systems (OEIS) Curriculum Model

The 1996 Office Systems Research Association's (OSRA) Organizational and End-user Information Systems (OEIS) Curriculum Model is directed toward "… collegiate preparation of individuals" and stresses that the use of their model must be flexible. "The OEIS Curriculum is designed for a four-year college and best fits in a school of business where students have a liberal arts foundation and study the core business curriculum."

The OSRA course content includes:

1. Overview of systems concepts and the current status of end-user and networking technologies (10%),
2. Identifying business applications (30%),
3. Workplace performance and productivity (20%),
4. Planning and implementing OEIS (20%),
5. OEIS training and support (10%), and
6. Organizational and managerial issues (10%).

This model was used as a basis, but because of a lack of inclusion of CS subjects was also not used in its entirety.

Computing Society of the Institute for Electrical and Electronic Engineers (IEEE-CS) and the Association for Computing Machinery (ACM) Computing Curricula 2001

The IEEE/ACM Computer Curricula 2001 (CC2001) model was still in the development stage and only early copies were included in this study. (The older Computing Curricula 1991 were not included in the study due to its age and lack of inclusion of newer technology and computer industry direction.) CC2001 will consist of five volumes; Vol. 1 Overview, Vol. 2 Computer Science, Vol. 3 Computer Engineering, Vol. 4 Software Engineering, and Vol. 5 Information Systems (see above). Abilities and skills are important in the CC2001 and include the three areas of:

- Cognitive abilities and skills relating to intellectual tasks specific to computer science
- Practical skills relating to computer science
- Additional transferable skills that may be developed in the context of computer science but which are of a general nature and applicable in many other contexts as well

The general characteristics of computer science graduates are outlined as:

- System-level perspective
- Appreciation of the interplay between theory and practice
- Familiarity with common themes
- Significant project experience
- Adaptability

A major reason for incorporating significant parts of the CC2001 is expressed by the editors in the Introduction. They state, “Past curriculum reports have all too often regarded computing as synonymous with computer science or computer engineering. While such an approach may have seemed reasonable thirty years ago, there is absolutely no question that computing in the 21st century encompasses many vital disciplines beyond these two.”

In addition to the five model curriculums incorporated in this case study, 43 college catalogs/curriculums were also studied for similar degree plans and prerequisites. The colleges under study were selected with the following criteria:

1) Enrollment 1500 – 2750 (PBAC: 2200+)

2) Offered either a CIS or CS major (PBAC: CIS)

3) Conferred a Bachelors level degree (PBAC: B.Sc.)

4) Accredited by the Southern Association of Colleges and Schools (SACS)

In an effort to complete this study in a timely manner it was decided to only make use of course catalogs and curriculums available on-line of the 43 colleges (see Appendix listing) that met the search criteria. A detailed study of the colleges found that majors in Computer Science and Computer Information Science were equally distributed, of those available. The median and average total hours for Bachelor of Science degrees was shown to be 126 (ranging from 120 – 131) while the median and average hours in the major were almost equal at 40 hours (ranging from 30 – 51). Of those degrees studied, the majority was under the Arts and Science or Mathematics departments and the curriculums showed a preponderance of required math courses. Whereas the remainder of the departments studied were either under Business divi-

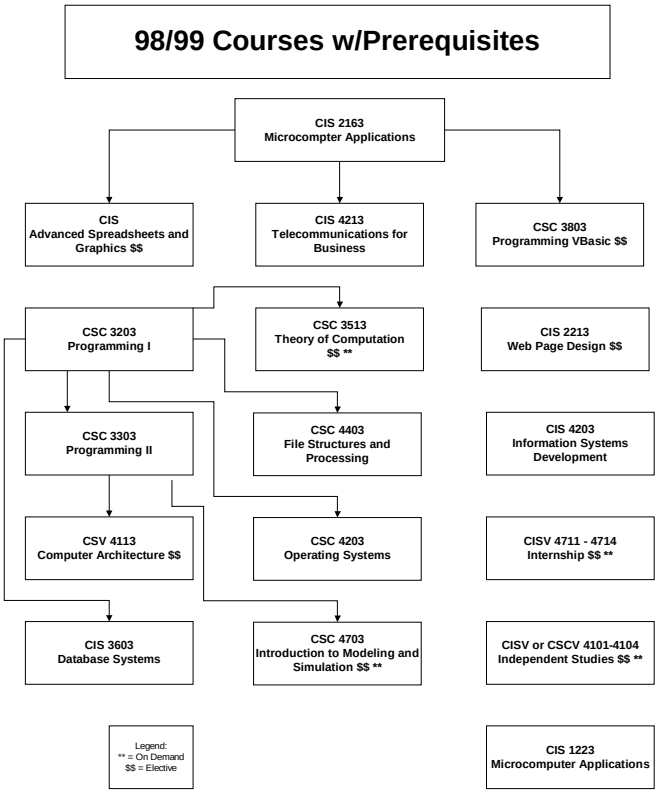

Figure 2: Organizational Chart:
Pre-study B.Sc. in C.I.S.

sions or Computer Science divisions and as such usually required additional Business/Accounting courses.

Curriculum Model 2000 of the Information Resource Management Association and the Data Administration Managers Association

According to Curriculum Model 2000 of the Information Resource Management Association and the Data Administration Managers Association (edited by Eli Cohen)

"This Curriculum Model addresses the needs of two distinct sets of learners:

1. students currently employed or seeking employment in the IRM field and,

2. all business students."

A seminal recommendation of the curriculum model is the introduction of a course in Information Resource Management.

According to editor Cohen (2000) the critical IRM concepts addressed in the curriculum model include:

- The recognition of information as the major organizational asset,
- An understanding of the principles of the characteristics, utilization and management of information,
- An appreciation of the value and importance of information resources in all functional areas of a business, and
- A familiarization with the value and types of information, characteristics of effective information, users and sources of information, economy of information, managerial functions in information-oriented decision-making, and the relationship between information resources and other organizational resources.

The Problem: B.Sc. in Computer Information Science, 1998/99

As a professor of programming languages it was found useful to flowchart the relationship of courses before beginning the process of revamping the curricula. According to previous years' college catalogs, as diagramed in Figure 2, the curriculum at PBAC has been added to and deleted from in varying patterns. The 1998/99 catalog lists two basic prerequisites, Microcomputer Applications and Programming I. This lack of a coherent curriculum plan caused professors to continually re-teach portions of subjects or see students dropout in frustration. It was also common for CIS majors to take courses out of order or sequence and thus leave them at a disadvantage compared to those that did follow a curriculum plan in

other disciplines. Of importance, also, was the lack of concrete curriculum prerequisites in place, as well as the lack of administrative adherence to the few prerequisites currently in the catalog.

Post-study Solution: B.Sc. in Computer Information Science, 2002/2003

The 8-step curriculum solution template (see Figure 1) includes being able to:

1) **Establish the exact nature of the curriculum problem(s)** which might include a:
   a. Lack of prerequisites,
   b. Lack of course plans in place with CIS Majors, and
   c. Lack of a long-range plan.

2) **Prioritize a needs list** possibly including a:
   a. One year plan listing immediate needs,
   b. A two and three year long-range plan of needs,
   c. Listing of possible experimental subjects for development, and
   d. Summarization of summer session plans for the next 3 years.

3) **Establish a long-range curriculum plan** for the CIS department with possible plans developed for Majors in acknowledged industry interrelated fields such as:
   a. CIS Generalist
   b. Webmaster/eCommerce
   c. Network Administration
   d. Programmer/Systems Analyst

4) **Consult accredited school catalogs for similar programs and M.I.S. textbooks for major areas of suggested study** (see Appendix) to:
   a. Determine what degree plans they offered,
   b. Total and major semester hours needed,
   c. What prerequisites were in place, and
   d. M.I.S. textbooks for recognized areas of study.

5) **Consult Model Curriculums** (see Bibliography) as proposed by accrediting agencies,

6) **Involve academic and industry leaders** in projecting the future of computer related disciplines by:
   a. Talking to and consulting with industry CIS/MIS departments, and
   b. Communicating with academic peers.

7) **Include elements of Felder's "active learning" by:**
   a. Incorporating 'touch and feel' activities in relevant courses, and
   b. Encourage students to become involved with industry through internships.

8) **Develop and implement a workable timetable with feedback.**

In essence the particular problem at P.B.A.C. was determined to be two-fold with changes needed in curriculum content, scholastic level (Junior, Senior, etc.), and order of prerequisites (see Figure 3). This approach not only provided a plan for students to follow, but also helped bring order out of a chaotic situation.

Implementation of the first phase of the reorganization of the curriculum (see Figure 3) shows that it now has a natural flow. Under the new plan once a student has completed the initial survey course of Microcomputer Applications (a survey of both 'Applications' and 'Computer Concepts'), they are then able to begin several paths branching from Programming I and Information Systems Development (which is an upper level survey of Information Technology). The rationale for ISD at this level is that it includes modules on Artificial Intelligence, Operating Systems, Database Management Systems, and Information Technology. Programming I (C++ as a structured and procedural language) is a prerequisite to advanced programming courses of Programming II (Object Oriented language) and Web Based Design (incorporating lower levels of web based languages) and ultimately to Internet Based Programming (Object Oriented upper level web based language). Once the student has completed the Internet Based Programming, Telecommunications, and Database Systems, then the branches come together in a Senior level capstone course designated eCommerce/eBusiness. eCommerce/eBusiness is designed to provide the Senior with an opportunity to develop a showcase of their abilities. It is expected that elements of not only their CIS curriculum will be in evidence, but also elements of their Business Administration and Liberal Arts education.

The second phase of the PBAC curriculum will incorporate inclusion of a second major track for the CIS undergraduate as noted above in step 3 of the 8 step template. This second track will be the first in a specialized area such as Network Management, Web-Master/eCommerce, or possibly Artificial Intelligence Development. The third phase will likewise be directed at developing a track within the CIS/IS/CS body of knowledge to better serve the undergraduates.

Conclusion

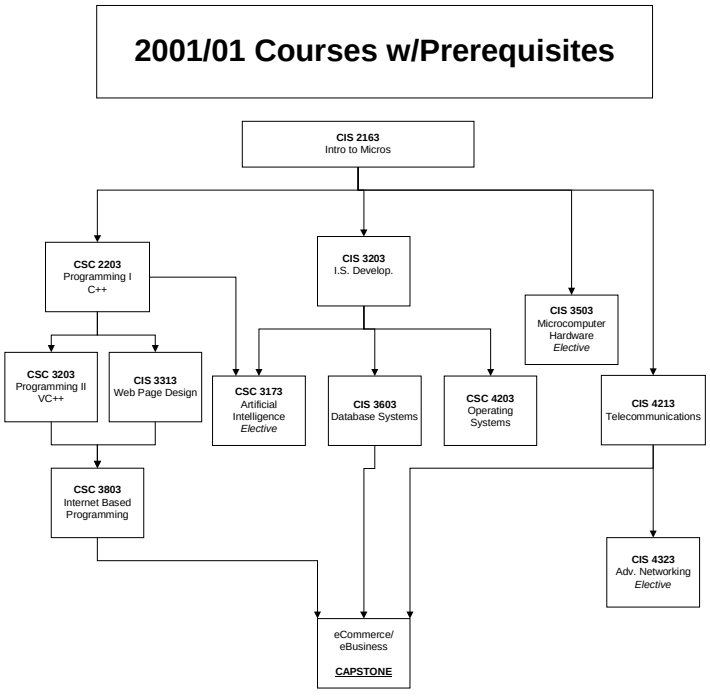

Figure 3: Organizational Chart:
Post-study B.Sc. in C.I.S.

This paper has described the materials and processes undertaken to update the curriculum of a moderately sized college endeavoring to maintain academic standards, meet the real life needs of students, and listen to the voice of industry. The curriculum outlined in this paper might not meet the needs of every college CIS/IS/CS department but as a template it can be of help in traveling like roads. Not many college computer departments are able to develop graduation plans that meet the needs of every student or that can fulfill every industry expectation, if they strictly follow only CS or IS model curriculums. Resources and other constraints are ever-present obstacles that the departments must contend with. What can be done? Schools can develop a degree plan that prepares the undergraduate to think for themselves, instills a pride in work accomplishments and ethics as well as developing in them the tools needed for the ever-

changing world of computer related work in industry. The ultimate reason that CS/CIS departments are in existence is to guide their charges in computer-based training and learning. Small to medium size colleges need to consider the ramifications of not providing their computer students a cross-discipline curriculum. Incorporating both subjective and objective learning into the college curriculum is vital to the well being of our students. The vehicle to accomplish this goal is the melding of CS and IS curriculums as documented in this case study.

Appendix

College Level Curriculum/Catalogs Used in Study

Search Criteria:

1500 – 2750 enrollment

Computer Information Systems / Computer Science Majors

Bachelors Degree Programs

States: AL, KY, LA, MD, MS, NC, TN, SC, TX, VA, GA, & FL

Benedict College, Columbia, SC http://www.benedict.edu/
Berry College, Mount Berry, Ga. www.berry.edu
Bethune Cookman College, Daytona Beach, Fl www.bethune.cookman.edu
Campbellsville University, Campbellsville, KY www.campbellsvil.edu
Christian Brothers University, Memphis, TN http://www.cbu.edu/
Cumberland College, Williamsburg, KY http://www.cumber.edu/
Dillard University, New Orleans, LA www.dillard.edu
Faulkner University, Montgomery, AL http://www.faulkner.edu/
Florida Memorial College, Miami, Fl www.fmc.edu
Freed-Hardeman University, Henderson, TN http://www.fhu.edu/
Hardin-Simmons University, Abilene, TX www.hsutx.edu
Hood College, Frederick, MD www.hood.edu
Jacksonville University, Jacksonville, FL www.ju.edu
Kentucky State University, Frankfort, KY http://www.kysu.edu/
Lenoir-Rhyne College, Hickory, NC http://www.lrc.edu/
Letourneau University, Longview, TX http://www.letu.edu/
Limestone College, Gaffney, SC www.limestone.edu
Lincoln Memorial University, Harrogate, TN www.lmunet.edu
Lynchburg Memorial University, Lynchburg, VA http://www.lynchburg.edu/
Methodist College, Fayetteville, NC www.methodist.edu
Mississippi Valley State University, Itta Bena, MS www.mvsu.edu
Morris Brown College, Atlanta, GA www.morrisbrown.edu
Mount Saint Mary's College, Emmitsburg, MD www.msmary.edu
North Carolina Wesleyan College, Rocky Mount, NC www.ncwc.edu
Oakwood College, Huntsville, AL www.oakwood.edu
Pfeiffer University, Misenheimer, NC http://www.pfeiffer.edu/

Roanoke College, Salem, VA www.roanoke.edu
Saint Augustine's College, Raleigh, NC http://www.st-aug.edu/
Saint Thomas University, Miami, FL www.stu.edu
Shaw University, Raleigh, NC www.shawuniversity.edu
Shenandoah University, Winchester, VA http://www.su.edu/
Southern Adventist University, Collegedale, TN www.southern.edu
Spelman College, Atlanta, GA http://www.spelman.edu/
The University of Texas of the Permian Basin, Odessa, TX www.utpb.edu
Trinity University, San Antonio, TX www.trinity.edu
Tusculum College, Greenville, TN http://www.tusculum.edu/
Union University, Jackson, TN www.uu.edu
University of Houston-Victoria, Victoria, TX http://www.vic.uh.edu/
University of Mary Hardin-Baylor, Belton, TX www.umhb.edu
University of Mobile, Mobile, AL http://www.umobile.edu/
Villa Julie College, Stevenson, MD www.vjc.edu
Washington and Lee University, Lexington, VA www.wlu.edu

References

Criteria for Accrediting Programs in Computer Science in the United States, Computer Science Accreditation Commission of the Computing Sciences Accreditation Board, January 2000, Version 1.0. http://www.cse.fau.edu/~roy/csab97/criteria962.html - P2.

Cohen, E. (ed.). (2000) Curriculum model of the Information Resource Management Association and the Data Administration Managers Association. Accessed December 26, 2001 from http://gise.org/IRMA-DAMA-2000.pdf.

Computing Curricula 2001, Computer Society of the Institute for Electrical and Electronic Engineers (IEEE-CS) and the Association for Computing Machinery (ACM), 2001, www.acm.org/sigcse/cc2001.

Felder, R. M. (1995). Active Learning: Who Said It Was Easy? *Chemical Engineering Education* 29(1): 32-33.

Information Systems-Centric Curriculum, ISCC '99, www.iscc.unomaha.edu.

IS '97, Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems, www.gise.org/links/pages/Curriculum_Models.

Mehic, N. & Al-Soufi, A. (1999). *Informing Science*, Vol. 1, No 4, http://inform.nu/.

Occupational Outlook Handbook, published by the U.S. Department of Labor's Bureau of Labor Statistics, Accessed at www.quintcareers.com/occuptional_outlook_handbook.html.

Organizational & End-User Information Systems (OEIS)/ Office Systems Research Association (OSRA) Curriculum Model, home.nyu.edu/~bno1/osra/model_curriculum & www.gise.org/links/pages/Curriculum_Models

PBC Works Survey 2001, Workforce Development Board, Inc. of Palm Beach County, survey2001.pbcworks.com/palmbeach/

Pearson R, Jagger N, Connor H, & Perryman S (IES) with de Grip A, Marey P, Corver F (ROA). *Assessing the Supply and Demand for Scientists and Technologists in Europe*, IES Report 377, 2001. ISBN 1-85184-306-X .

U.S. Department of Commerce, Office of Technology Policy. (1999). America's New Deficit: The Shortage of Information Technology Workers.

Biography

William Burkett is Chair and Assistant Professor of Computer Information Systems at Rinker School of Business, Palm Beach Atlantic College. He received his B.S. from Palm Beach Atlantic College, his M.S. from Nova Southeastern University, and his Ph.D. from Nova Southeastern University.

He serves as President of the Palm Beach Atlantic College chapter of Sigma Beta Delta (National Honor Society in Business, Management, and Administration). He is active in research in computer anxiety, older adults, computer based training and learning, and robotics. Formerly, he was Systems Manager, State of Florida, Marine Supervisor of Offshore Seismic Vessels, and Safety Engineer, Teledyne Exploration, Inc., and Petty Officer, United States Coast Guard. He is a member of Association for Computing Machinery, American Association for Artificial Intelligence, and Association of Information Technology Professionals.