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An Update on the CIS Curriculum Project

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Abstract

Computing curricula have been developed since the 1950's to support the ever advancing computing hardware by the ACM, DPMA, and EDSIG organizations. In this paper we present a method to develop the Computer Information Systems (CIS) model curricula based on a body of knowledge, exit objectives using course level learning outcomes incorporating both on the body and exit objectives. Integration of learning outcomes into courses is presented.

Keywords: Model Curriculum, Computing, Education, Body of Knowledge, Skills

1. INTRODUCTION

Computers in the mid 1950's were applied to development and use for information systems applications. While the goal of information systems remains largely unchanged—Information Systems (IS) purpose is to facilitate the work of people in an organization through the application of information technology – the scope of information systems broadens over time. IS education was initially focused on the development of software programs done on and

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for small computers (ACM, 1968). As the power of computer has expanded by orders of magnitude so has the task complexity and scope of applications matured from the single machine single user to thousands of people using global applications (DPMA 1981, 1986; Nunamaker et al, 1982; Longenecker et al., 1995; Gorgone, et al., 2003; Topi, H., et al., 2010). Correspondingly, IS education faces the challenge of matching the growing complexity and impact of computer hardware and application systems.

In this paper, we will explore the concept of partitioning the field in a manner similar to other disciplines such as engineering, the sciences, medicine, etc. We already know that within computing there are several sub-disciplines--e.g. Information systems, software engineering, computer science, information technology, networking, and security (Shakleford et al, 2006). Our goal is to explore the idea that IS education can likewise benefit from factoring – analogous to medicine where a central core of knowledge persists and is common to all its sub-disciplines. Although common the core knowledge may still best be conveyed through discipline specific pedagogy.

2. COMPARISON OF MEDICAL AND COMPUTING EDUCATION

In computing education, the specializations could include computer science, software engineering, security, networking, information systems, data science as well as other disciplines recognized within the ACM family of computing curricula. This is a strong parallel to the medical field. We suggest that there could be a common computing curriculum, or at least a common body of knowledge shared within computing specializations. This is consistent with the manner in which ABET's Computing Accreditation Commission has viewed computing programs – Specifying common curricular aspects while providing for variations among the sub-disciplines in computing. An important aspect of this approach is that no single computing discipline is conveyed as prominent/dominant over others, and that each computing discipline emanates from key foundations shared among computing disciplines.

In our examination of the portfolio of computing curricula documented by Shakleford, et al. (2006) we identified themes denoting elements core to a foundational body of knowledge. We gathered the element titles from the portfolio eliminating duplication. We posit a preliminary gauge of the depth of knowledge appropriate to each element in a four-year academic program based upon a pilot survey focused on experienced computing curriculum developers (Longenecker et al, 2013). The elements were then organized according to a typical systems development life cycle, except for project management and information technology. The resulting knowledge element list is presented as Appendix 1.
For IS and CIS (Longenecker et al, 2013) programs, the body of knowledge can be summarized in six major areas including: Database, systems analysis, systems design, software planning/programming/testing, project management, and IT technology, IT management/security. While much of computing is technical in nature, there is a strong dependency on business knowledge, team, and both individual/interpersonal abilities.

In the case of a practicing neurosurgeon or neurologist, one might wonder about the relevance of anatomy, biochemistry, cell biology and other "basic" medical science courses to disciplinary practice. Yet, many years of experience have validated the dependency of the specializations on these courses. Furthermore, the advanced areas (e.g. neurology) are integrated into the undergraduate medical curriculum. Yet, "medicine" remains the focus and is examined at the end of the curriculum in the medical board exam.

So, one might ask what are the "basic" computing areas relevant to an IS degree? One might argue that the ACM curricula each represent a specific path to a unique disciplinary Bachelor of Science degree, and that by adding courses (or focused fragments) to the undergraduate model such as software engineering, database, or networking a useful breadth could be established. More intense levels of knowledge can be attained with graduate degrees not unlike residency experiences. Traditionally this has made sense; however, turf wars in teaching courses at all levels of an undergraduate experience have produced very discipline-focused courses particularly within freshman and sophomore years. Yet they are founded on the same body of knowledge. The same knowledge is cast differently in a sub-discipline specific context.

3. EXIT OBJECTIVES EXPRESS CURRICULAR GOALS

We have argued that the body of computing knowledge can be cast in a manner centrally relevant to computing ispo facto, and then be

mapped to sub-discipline specific course plans consistent with the exit objectives for that field. We argue that the body of knowledge can also be mapped to a set of exit objectives known to be a valid target for that profession. Further, we use the term (sub)-discipline in referring to disciplines such as information systems, information technology, or computer science as we argue in favor of considering computing to be an overarching term to which some central concerns will span across sub-disciplines

We propose a series of educational objectives supporting the IS discipline that reflect the Standish Group's (2001, 1995) findings indicative of successful systems development (Longenecker et al, 2015). The Standish Group initially reported on failures in the development process of IS systems (Standish Group, 1995, 2001). Regrettably, they were not able to find a high percentage of successes for their studies. We analyzed their documents to identify the principles they reveal for the successful development of information systems. We identified five principles in our analysis. (See Table 1, and Appendix 2).

1.	Accurate business plan developed by end users, management, and developers
2.	Translation of requirements into viable software
3.	Exceptional requirements analysis
4.	Deployment of software product
5.	Project management based on established formal written methodology

Table 1. Exit Objectives for IS programs

While we believe the Standish Group's data to be compelling as a characterization of issues worthy of attention, we would be remiss to not acknowledge that some have found issues with the CHAOS report methodologically (Ambler, 2014). As such, there cannot be doubt that Information Systems failures remain a compelling source for strategy concerning where our curricular attention is warranted (Lyytinen and Hirschheim, 1987).

4. MAPPING THE BODY OF KNOWLEDGE TO THE EXIT OBJECTIVES

We wanted to be able to answer the question, "What knowledge underpins each of the five principles contained in Table 1?" The high level objective was chosen, and body of knowledge was searched. If a high level objective contained the body of knowledge element it was moved under the high level title. This process was carried out until no high level objectives remained. The data contained in Appendix 3 is the complete mapping. This mapping shows precisely how the body was utilized in producing a program optimized (because of the exit objectives derived from the Standish Group, 1991, 2001).

5. DEVELOPMENT OF COURSE LEVEL LEARNING OUTCOMES

For the purpose of this paper we define a structure of "Learning Outcome"; A learning outcome, written in Bloom terms (1956; Couger et al 1995; Couger, et al 1997; Davis et al,1997; Gorgone et al 2003), gives a description of the learner capability at the end of a period of study. This is a definition consistent also with ABET's definition of an outcome. The learning outcome must connect to one of the sub-objectives and to one or more bodies of knowledge elements. Critical factors such as design (Waguespack, 2011; Babb & Waguespack, 2014) must be recognized. The purpose of these outcomes is to serve as course level outcomes in addition to specifying expectations of learners. (See Appendix 4).

As a course is specified by a curriculum designer, there should be a collection of learning outcomes assigned to the course. The outcomes may be selected as needed from the entire list of outcomes. However, at the end of the course design process, all learning outcomes should have been used. Outcomes may be used redundantly used in multiple courses. We have tried to write approximately 20 outcomes per 45 hours including exams and/or quizzes.

A set of courses which has been designed to utilize the complete set to learning outcomes and be assured that the body of knowledge is represented and utilized for the benefit of the learners. Likewise, the course plan utilizes the learning outcomes that can be assured to be compliant with the strongest evidence (through the exit objectives) for success.

6. ADVANCED OR SPECIALTY COURSES

There is nothing to preclude an undergraduate program from offering a course or sequence to explore advanced concepts including analytics, security, or big data, for example. We suggest that this additional material be completed as well as the sequences presented herein.

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To implement the new material structures parallel to those presented here should be completed. This would include developing extensions to the body of knowledge and exit objectives. Then the body of knowledge can be mapped to the exit objectives and learner outcomes. Course plan(s) can be developed to present the new material.

7. CONCLUSION

This paper is offered as a brief in order to share progress from an ongoing effort to explore a CIS curriculum as an activity of a CIS Task Force under the auspices of AITP-EDSIG. This progress is not offered as being conclusive, authoritative, or representative of AITP-EDSIG, but is rather an effort to explore the role AITP-EDSIG may serve in ongoing efforts for curriculum development. The intent here is to foster discussion and consideration of the evolution of curriculum in the information systems sub-discipline with special consideration for educators.

8. ACKNOWLEDGEMENT

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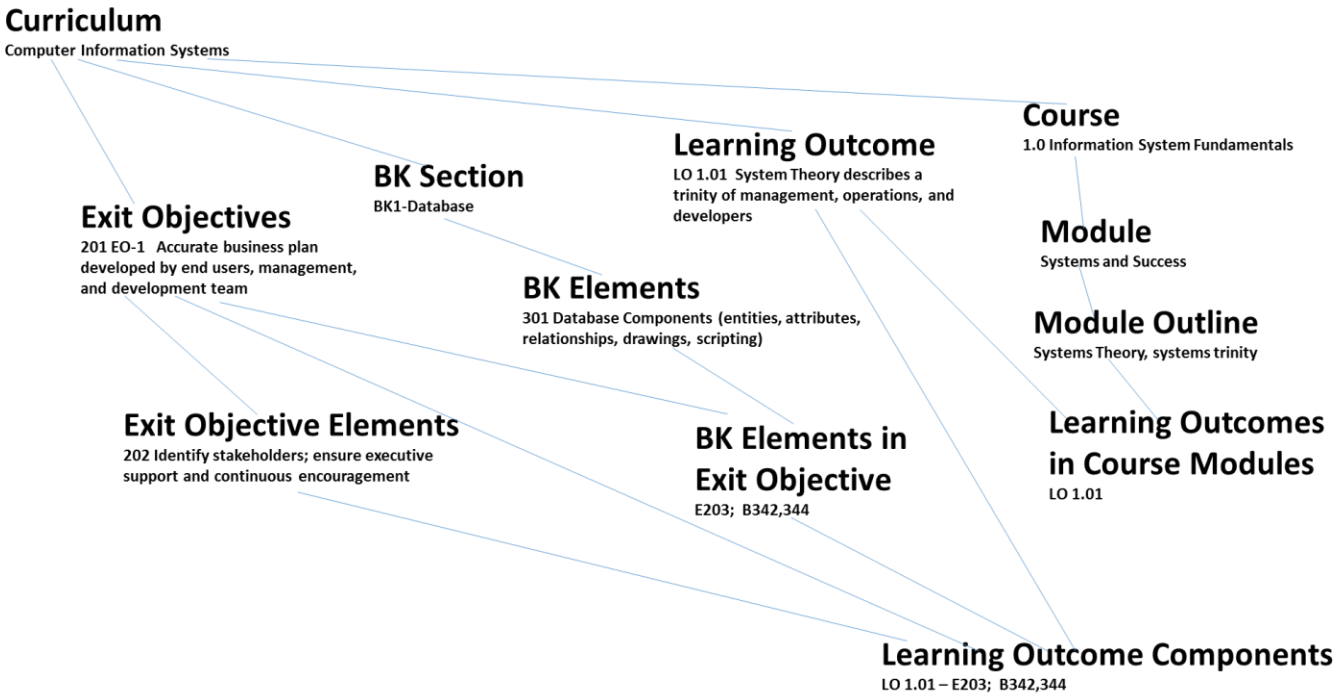
Appendix 0: Relationship between curriculum components



The **CURRICULUM** contains material illustrated in Appendix material 1 .. 5

Appendix 1 contains **BK** (body of knowledge) and **BK ELEMENTS**

Appendix 2 contains **EO** (exit objectives) and **EO ELEMENTS**

Appendix 3 contains a map of **BK ELEMENTS** to **EO** showing **EO ELEMENTS** involved

Appendix 4 shows the map of appendix 3 with **LEARNING OUTCOMES** mapped to EO

Appendix 5 shows **COURSES** and related **COURSE MODULES** and **MODULE OUTLINES** related **LEARNING OUTCOMES**

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Appendix 1: CIS Body of Knowledge

(Note: the appendix material is numbered sequentially. The numbers do not connote a hierarchy. The numbers start in sections from an even hundred, e.g. 300. The numbers are referred to by other appendices.) The data is based on research of The CIS Task Force of AITP-EDSIG (Longenecker, et al, 2013)

300 BK-1 Database

301 Database Components (entities, attributes, relationships, drawing, scripting)
302 Database Structuring (Create, Modeling, Quality, integrity, data types, data, and indexes)
303 Database Access (DDL, DML, Transaction Processing, Stored Procedures; blocking injection attacks)
304 Database Services (ETL, Report Services, BI, DSS, Backup, Replication, Security Management, Administration)
305 Big Data (characteristics, MapReduce, Hadoop, big data analytics, visualization, applications [government, electioneering, health care, marketing, media, Google, sales organizations])

306 BK-2 Information System Development

307 IS Development: Planning; organizational purpose; feasibility; privacy; security; alignment, security, scope minimization and management
308 IS Development: Make or Buy
309 IS Problem Definition, Optimization, Requirements Elicitation, security planning; BPR Analysis
310 IS Organization Development with New IS (IT enabling, improved IT alignment, lower resistance, raised involvement)
311 IS Design Maturity (levels within apprenticeship, design-leadership)
312 IS System Verification/Validation Planning
313 IS Development Test Plan
314 IS Verification with Customer
315 Assertion of Quality Policy
316 IS Test and Validate (Module, Application, and System)
317 IS Final Evaluation, Deployment and Operation
318 IS Team and Interpersonal Skills (leadership, emotional intelligence, goal setting, empowerment, change, meetings design and management, teams, innovative learning, critical thinking, emotional maturity, develop a security culture)
319 IS Life Cycle Tools (Agile, methodologies, support Systems, Bloom and learning for clients and staff)

320 BK-3 Information Systems Design

321 IS Design (Architecture, Frameworks, Creativity, Reflection, video, voice)
322 IS Application Design (Requirements, Modules, Verification, planning for security)
323 IS Design Paradigms (cash management, new accounts, new addresses, new organization interaction, international actions, interfaces management, security procedure, Sarbanes Oxley, HCI management, HH device utilization)
324 IS BPR, Data Transformations, Reporting, BI, analytics (descriptive, predictive, risk, security, data mining)
325 IS Design Standards, Privacy and Security, Policies, Regulation and Compliance
326 Risk Management for Security
327 Ensuring legal aspects of IS (fraud detection, standards [HIPAA, SOX, Patriot Act], computer forensics [evidence, chain of custody, documentation])
328 IS Design Quality (Verification and validation, qualitative and quantitative-assessments)
329 IS Systems Testing and Implementation
330 IS Configuration and Change Management

331 BK-4 Software Planning, Programming, Testing

332 Programming Logic and Design (computers, programming, programs, control structures, sequence, selection, loop, arrays, records, modules, parameters, OO, events, files and DB)
333 Programming Implementation (Languages, Environments, Compilers, Local, Web Environment; Code-a-little--test-a-lot; developing small working objects building a business function and presenting it, scripting; secure coding)

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334 Languages (C++, C#, VB.net, Java Script, HTML, ASP)
335 OO Programming (OO Structures, concepts, implementation with an IDE, testing
336 Software Engineering (Requirements, Simple Algorithms and Data Structures, Modules, Box Structured Design, Programming, Quality)
337 Software Implementation (Requirements, Design, Modular Top Down Implementation, Testing, Validation, packaging, installation, operation, use Agile)
338 Software Management (Development, Maintenance, documentation, standards, performance)
339 Software and system maintenance (strategy, updates and issues, problem analysis, establishing parallel systems, repairs, documentation, testing, re-integration)

340 BK-5 IS Project Management

341 Project Management Responsibilities and Selection: (knowledgeable of project management techniques [e.g. Agile], organizational project requirement [goals], management and communication skills with management and team, honest, ethical; ability to learn new project demands and share processing them into viable and exciting information structures and systems; ability to direct, encourage, empower and control teams)
342 IS Professionalism (systems thinking, organizational behaviors, encouraging, legal issues, use of standards, ethical issues, social issues, concepts of performance, practicing success habits, life-long learning)
343 Teaming (ensure team training, ensure leadership development, improve group emotional intelligence, managing disputes, attaining certification 342 Project Meetings (pre-meeting [goal setting, participants, agenda—construction, techniques, timing], post-meeting [documentation, follow-up scheduling, evaluation])
344 Project Meetings (pre-meeting [meeting goal setting, participants, agenda—construction with critical thinking, using known techniques, setting agenda timing], post-meeting [documentation, follow-up planning and scheduling, evaluation])
345 Project Initiation (Strategy, stakeholder analysis, plan, scope [optimizing, minimizing], security planning)
346 Project Communication (Classification, frequency, secure communications, responsibilities, monitoring)
347 Project Staff (Function, Responsibilities, Qualification, Reporting, Monitoring, rewards)
348 Project Risk (Management, issues log, risk log)
349 Project Execution and Control (quadruple constraint, controlling activities, conflict resolution, notification of management on a timely basis, negotiating changes; ensure standards & quality; tools: Gantt, PERT, security management)
350 Work Break-Down (Structure, Schedule--upcoming and completed events)
351 Project Change Management (triggered by [lateness, uncertainty, inaccurate estimation or communication, unclear project methodology], negotiated recommendation with management, revised requirements, cost, planned rework and other suggestions)
352 Project Closedown (Acceptance, reviews, final reporting)

353 BK-6 Technology, IT Management and Security

354 Using IT governance (ITIL, regulatory standards, compliance)
355 IA Fundamentals (Vulnerabilities, Risks, Mitigation, threats, attacks, incident management, Security Policy Principles and Design)
356 Computer Architecture and Organization (functional blocks, busses, instruction management, memory, cycles)
357 Networks and Communications (security issues, devices [cable, fiber, modem, router, switch packet shaper, protocols, servers, sniffers], network design, testing and maintenance, cyber-attacks and prevention)
358 Operating Systems (Concepts, ISO levels, installation and configuration, management and maintenance, drivers, security issues)
359 Storage management systems (systems, RAM, ROM, microcode, virtual memory, device buffers)
361 Virtualization (operating system, memory, storage, data, networks; VM)
362 Desktop virtualization (VD infrastructure, software simplification, cloud VDs)
363 System Operation (software/hardware administration, maintenance, security)

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364 Power Management (requirements, regulation, system protection, redundancy, backup, EMP protection, shielding, planning for long periods of blackout, prevention of cyber-attacks)

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Appendix 2: Exit Objectives

(Note: the appendix material is numbered sequentially. The numbers do not connote a hierarchy. The numbers start in sections from an even hundred, e.g. 300. The numbers are referred to by other appendices.) These exit objectives are based on the work of the Standish Group (1995, 2001).

201 EO-1 Accurate business plan developed by end users, management and development team
202 Identify stakeholders; ensure executive support and continuous encouragement
203 Identify and qualify business knowledgeable project manager to deliver a competitive business plan
204 Establish user—developer—management interactions to ensure involvement, and development of clear business objectives aligned to organizational goals and strategy
205 Choose a development methodology (e.g. Agile)

206 EO-2 Exceptional requirements analysis
207 Must use a User-Centered Focus
208 Must express IT alignment with a high degree of maturity
209 Identify System Requirements including access controls, risk detection/mitigation, audit controls
210 Must be tied to a verification and validation mechanism
211 Must involve and develop excellent teams with strong personal and interpersonal skills, critical thinking ability, develop emotional intelligence, business and technology skills, agile ability, fluent programming, demonstrated security awareness and ability to use of security standards

212 EO-3 Translation of Requirements info viable software
213 Should consider using Agile approach; deliver working software products frequently
214 Must use well established software engineering and programming practices, including reuse
215 Must have exceptional database modeling and implementation skill
216 Use appropriate reporting and data analytics
217 Must apply quality principles

218 EO-4 Deploy Software Product
219 Install system on IT host
220 Use virtualization as beneficial
221 Test Software, prove quality
222 Validate security mechanisms
223 Test System and certify

224 EO-5 Project Management based on established formal written methodology
225 Initiate project thoroughly understood by the project manager to meet or exceed stakeholder expectations and provide value to the organization
226 Establish project communication
227 Must set important milestones and check points
228 Perform project risk assessment and management
229 Assure project/product security
230 Utilize reusability
231 Manage scope of business requirements to ensure business effectiveness by optimizing a collection of many small projects
232 Develop WBS tied to system development life-cycle
233 Establish configuration management
234 Execute project subject to quadruple constraint; minimize scope
235 Use project control tools PERT/Gantt; requirement tools; collaborative tools

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Appendix 3: CIS 2017 Model Curriculum Project: Map BK to EO

Exit Objectives – Exit objectives are a collection of behaviorally written statements, which define characteristics expected of graduates so they will be able to fit into the fabric of an industry position. This collection of objectives is inclusive of the recommendations of the Standish Group (1995,2001) research based on studies of at least 100,000 projects, many of which failed. All of the exit objectives of appendix 2 are mapped 1:n.

Body of Knowledge – Elements of the CIS Body of Knowledge are mapped to Exit Objectives, and the results are displayed below. The meaning of this relationship is that the educational objectives were completely enabled (supported) by the body of knowledge. All of the body of knowledge elements are mapped 1:n to the highest level Exit Objectives.

201 EO-1 Accurate business plan developed by end users, management and development team

Exit Objectives

202 Identify stakeholders; ensure executive support and continuous encouragement
203 Identify and qualify business knowledgeable project manager to deliver an excellent competitive business plan
204 Establish user—developer—management interactions to ensure involvement, and development of clear business objectives aligned to organizational goals and strategy
205 Choose a development methodology (e.g. Agile)

Body of Knowledge

342 IS Professionalism (systems thinking, organizational behaviors, encouraging, legal issues, use of standards, ethical issues, social issues, concepts of performance, practicing success habits, life-long learning)
343 Teaming (ensure team training, ensure leadership development, improve group emotional intelligence, manage disputes, and attain certifications
344 Project Meetings (pre-meeting [meeting goal setting, participants, agenda—construction with critical thinking, using known techniques, setting agenda timing], post-meeting [documentation, follow-up
307 IS Development: Planning; organizational purpose, aligned strategy and goals; feasibility; privacy; security; alignment, security, scope minimization and management

206 EO-2 Exceptional requirements analysis

Exit Objectives

2O7 must have a User-centered-Focus
208 Must express IT alignment with a high degree of maturity
209 Identify System Requirements including access controls, risk detection/mitigation, audit controls
210 Must be tied to a verification and validation mechanism
211 Must involve and develop excellent teams with strong personal and interpersonal skills, critical thinking ability, develop emotional intelligence, business and technology skills, agile ability, fluent programming, demonstrated security awareness and ability to use of security standards

Body of Knowledge

341 Project Management Responsibilities and Selection: (knowledgeable of project management techniques [e.g. Agile], organizational project requirement [goals], management and communication skills with management and team, honest, ethical; ability to learn new project demands and share processing

them into viable and exciting information structures and systems; ability to direct, encourage, empower and control teams)
342 IS Professionalism (systems thinking, organizational behaviors, encouraging, legal issues, use of standards, ethical issues, social issues, concepts of performance, practicing success habits, life-long learning)
343 Teaming (ensure team training, ensure leadership development, improve group emotional intelligence, manage disputes, and attain certifications
344 Project Meetings (pre-meeting [meeting goal setting, participants, agenda—construction with critical thinking, using known techniques, setting agenda timing], post-meeting [documentation, follow-up planning and scheduling, evaluation])
308 IS Development: Make or Buy
309 IS Problem Definition, Optimization, Requirements Elicitation, security planning; BPR Analysis
310 IS Organization Development with New IS (IT enabling, improved IT alignment, lower resistance, and improved involvement)
311 IS Design Maturity (levels within apprenticeship, design-leadership)
312 IS System Verification/Validation Planning

212 EO-3 Translation of Requirements info viable software

Exit Objectives

213 Should consider using Agile approach; deliver working software products frequently
214 Must use well established software engineering and programming practices, including reuse
215 Must have exceptional database modeling and implementation skill
216 Use appropriate reporting and data analytics
217 Must apply quality principles

Body of Knowledge

318 IS Team and Interpersonal Skills (leadership, emotional intelligence, goal setting, empowerment, change, meetings design and management, teams, innovative learning, critical thinking, emotional maturity, develop a security culture)
321 IS Design (Architecture, Frameworks, Creativity, Reflection, video, and, voice)
322 IS Application Design (Requirements, Modules, Verification, planning for security)
323 IS Design Paradigms (cash management, new accounts, new addresses, new organization interaction, international actions, interfaces management, security procedure, Sarbanes Oxley, HCI management, HH device utilization)
324 IS BPR, Data Transformations, Reporting, BI, analytics (descriptive, predictive, risk, security, and data mining)
325 IS Design Standards, Privacy and Security, Policies, Regulation and Compliance
326 Risk Management for Security
327 Ensuring legal aspects of IS (fraud detection, standards [HIPAA, SOX, Patriot Act], computer forensics [evidence, chain of custody, documentation])
328 IS Design Quality (Verification and validation, qualitative and quantitative-assessments)
329 IS Systems Testing and Implementation
330 IS Configuration and Change Management
301 Database Components (entities, attributes, relationships, drawing, scripting)
302 Database Structuring (Create, Modeling, Quality, integrity, data types, data, and indexes)
303 Database Access (DDL, DML, Transaction Processing, Stored Procedures; blocking injection attacks)
304 Database Services (ETL, Report Services, BI, DSS, Backup, Replication, Security Management, Administration)
305 Big Data (characteristics, MapReduce, Hadoop, big data analytics, visualization, applications [government, electioneering, health care, marketing, media, Google, sales organizations])
332 Programming Logic and Design (computers, programming, programs, control structures, sequence, selection, loop, arrays, records, modules, parameters, OO, events, files and DB)
333 Programming Implementation (Languages, Environments, Compilers, Local, Web Environment; Code-a-little—test—a—lot; developing small working objects building a business function and presenting it, scripting; secure coding)
339 Software and system maintenance (strategy, updates and issues, problem analysis, establishing parallel systems, lot; developing small working objects building a business function and presenting it, scripting; secure coding)

334 Languages (C++, C#, VB.net, Java Script, HTML, ASP)
335 OO Programming (OO Structures, concepts, implementation with an IDE, testing
336 Software Engineering (Requirements, Simple Algorithms and Data Structures, Modules, Box Structured Design, Programming, Quality)
337 Software Implementation (Requirements, Design, Modular Top Down Implementation, Testing, Validation, packaging, installation, operation, use Agile)
338 Software Management (Development, Maintenance, documentation, standards, performance) repairs, documentation, testing, re-integration)

218 EO-4 Deploy Software Product

Exit Objectives

219 Install system on IT host
220 Use virtualization as beneficial
221 Test Software, prove quality
222 Validate security mechanisms
223 Test System and certify

Body of Knowledge

354 Using IT governance (ITIL, regulatory standards, compliance)
355 IA Fundamentals (Vulnerabilities, Risks, Mitigation, threats, attacks, incident management, Security Policy Principles and Design)
356 Computer Architecture and Organization (functional blocks, busses, instruction management, memory, cycles)
357 Networks and Communications (security issues, devices [cable, fiber, modem, router, switch packet shaper, protocols, servers, sniffers], network design, testing and maintenance, cyber-attacks and prevention)
358 Operating Systems (Concepts, ISO levels, installation and configuration, management and maintenance, drivers, security issues)
363 System Operation (software/hardware administration, maintenance, security)
364 Power Management (requirements, regulation, system protection, redundancy, backup, EMP protection, shielding, planning for long periods of blackout, prevention of cyber-attacks)

224 EO-5 Project Management based on established formal written methodology

Exit Objectives

225 Initiate project thoroughly understood by the project manager to meet or exceed stakeholder expectations and provide value to the organization
226 Establish project communication
227 Must set important milestones and check points
228 Perform project risk assessment and management
229 Assure project/product security
230 Utilize reusability
231 Manage scope of business requirements to ensure business effectiveness by optimizing a collection of many small projects
232 Develop WBS tied to system development life-cycle
233 Establish configuration management
234 Execute project subject to quadruple constraint; minimize scope
235 Use project control tools PERT/Gantt; requirement tools; collaborative tools

Body of Knowledge

341 Project Management Responsibilities and Selection: (knowledgeable of project management techniques [e.g. Agile], organizational project requirement [goals], management and communication skills with management and team, honest, ethical; ability to learn new project demands and share processing them into viable and exciting information structures and systems; ability to direct, encourage, empower and control teams)

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342 IS Professionalism (systems thinking, organizational behaviors, encouraging, legal issues, use of standards, ethical issues, social issues, concepts of performance, practicing success habits, life-long learning)
343 Teaming (ensure team training, ensure leadership development, improve group emotional intelligence, manage disputes, and attain certifications
344 Project Meetings (pre-meeting [meeting goal setting, participants, agenda—construction with critical thinking, using known techniques, setting agenda timing], post-meeting [documentation, follow-up planning and scheduling, evaluation])
345 Project Initiation (Strategy, stakeholder analysis, plan, scope [optimizing, minimizing], security planning)
346 Project Communication (Classification, frequency, secure communications, responsibilities, monitoring)
347 Project Staff (Function, Responsibilities, Qualification, Reporting, Monitoring, rewards)
348 Project Risk (Management, issues log, risk log)
349 Project Execution and Control (quadruple constraint, controlling activities, conflict resolution, notification of management on a timely basis, negotiating changes; ensure standards & quality; tools: Gantt, PERT, security management)
350 Work Break-Down (Structure, Schedule--upcoming and completed events)
351 Project Change Management (triggered by [lateness, uncertainty, inaccurate estimation or communication, unclear project methodology], negotiated recommendation with management, revised requirements, cost, planned rework and other suggestions)
352 Project Closedown (Acceptance, reviews, final reporting)

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Appendix 4 –Sample Result of Development of Local Objectives

Exit Objectives – Exit objectives are a collection of behaviorally written statements, which define characteristics expected of graduates so they will be able to fit into the fabric of an industry position. This collection of objectives is inclusive of the recommendations of the Standish group their research based on studies of at least 100,000 projects, many of which failed.

Body of Knowledge – The CIS Body of Knowledge Elements are mapped to Exit Objectives, and the result is displayed below. An M: N mapping was allowed. The meaning of this relationship is that the educational objectives were completely enabled (dependent upon) the body of knowledge.

Outcomes – Learner outcomes, stated behaviorally, describe behaviors expected of learners at the conclusion of a period of study for the identified collection of data. The outcomes are written in Bloom terms. The outcomes are developed by answering the question, "For a course of study, state a sequence of outcomes that describe the results of study." Approximately 20 outcomes are described for each 3 semester.

2201 EO-1 Accurate business plan developed by end users, management and development team

Exit Objectives

202 Identify stakeholders; ensure executive support and continuous encouragement
203 Identify and qualify business knowledgeable project manager to deliver an excellent competitive business plan
204 Establish user—developer—management interactions to ensure involvement, and development of clear business objectives aligned to organizational goals and strategy
205 Choose a development methodology (e.g. Agile)

Body of Knowledge

342 IS Professionalism (systems thinking, organizational behaviors, encouraging, legal issues, use of standards, ethical issues, social issues, concepts of performance, practicing success habits, life-long learning)
343 Teaming (ensure team training, ensure leadership development, improve group emotional intelligence, manage disputes, and attain certifications
344 Project Meetings (pre-meeting [meeting goal setting, participants, agenda—construction with critical thinking, using known techniques, setting agenda timing], post-meeting [documentation, follow-up
307 IS Development: Planning; organizational purpose, aligned strategy and goals; feasibility; privacy; security; alignment, security, scope minimization and management

Learning Outcomes and Knowledge Network (please note, these LO's are a partial subset)

LO1.01 – E 203: B 342,344
System theory describes a trinity of management, operations, and developers. Be able to write a 3-5 page paper describing the organization roles of each organizational component.
LO1.02 – E 204: B 342,343
To describe an excellent business plan developed through exceptional group emotional intelligence involving the systems trinity
LO1.03 – E 203: B 343,344,307
to discuss the meeting wherein LO1.02 where in an exceptional business plan could have been developed.
LO1.04 -- E 204: B 342,344
to identify, discuss, and explain the components of emotional intelligence, and to show how development of "group" emotional intelligence is essential for successful meetings.

LO1.05 -- E 204: B 342,307
to describe the system theory based argument that physical activity in organizational process can be related to systems representations, including related data structures.

Appendix 5 -- Sample Course Module

The purpose of this appendix is to show the relationships and usage of the derived outcomes of Appendix 4. A Program which desires to be consistent with the overall outcomes expressed with the Exit Objectives. Should design course utilizing all of the learning outcomes specified in a complete version of Appendix 4. The sample module before shows how the curriculum designer could incorporate the learning outcomes in a course module.

Curriculum contains courses contain modules specified by outlines and define the learning outcomes for the module.

Sample Course: Information System Fundamentals

The course presents fundamentals of information systems. It is a hands on lecture/lab experience weighted more towards developing experience. The course contains a number of modules. Teaching style is the responsibility of the instructor.

Sample Module Outline

This module provides information necessary to satisfy the following concepts taken from a set of learning outcomes, e.g. 1.01. How modules are developed are up to the instructor. The CIS task force will supply a set of modules that will achieve the exit objectives completely. Please observe, the number in () is a learning outcome, in this 1.01:

Module m of course n
--Systems theory, the systems trinity (1.01)
--Meetings concepts--pre and post meetings, relationship to system theory, relevant data, meeting errors (1.03)
--Success Principles--Stephen Covey habits of success; listening (Shapiro) (1.16)
--Teams--team success and failures, emotional intelligence, critical thinking (1.02, 1.14)

Material of the module supports the following learning outcomes:

LO1.01 – E 203: B 342,344
System theory describes a trinity of management, operations, and developers. Be able to write a 3-5 page paper describing the organization roles of each organizational component.
LO1.02 – E 204: B 342,343
To describe an excellent business plan developed through exceptional group emotional intelligence involving the systems trinity
LO1.03 – E 203: B 343,344,307
to discuss the meeting wherein LO1.02 where in an exceptional business plan could have been developed.
LO1.14 – E 205: B 343
to explain the stages of critical thinking; to express what must happen at each stage, and to discuss the relationships between each stage.
LO1.16 – E 204: B 342,343

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to express the success habits of Dr. Stephen R. Covey, to express mastering the habits sequentially, and to recognize that application of the habits requires effort over a period of time; and to equate the performance of groups with high emotional intelligence as capable of practicing habits 5 and 6 of Covey

Supporting course plan. (not shown) describes the course approach and satisfying the LO's.

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