Software Academic Initiatives:
A Framework for Supporting a Contemporary Information Systems Academic Curriculum

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Abstract

Information Systems accreditation bodies require degree granting programs to adequately support and make available computing resources to appropriately prepare students in advanced Information Systems areas. Corporations in the software applications business strive to use the latest software tools in building and managing their applications. Students graduating from Information Systems programs should have the ability to design and implement information technology solutions using these software tools. Accordingly, keeping a portfolio of software tools that is current and complies with industry needs, supports an Information Systems curriculum, and within a managed budget is a challenging task. In this paper we evaluate offerings from three different commercial academic initiatives (Microsoft, IBM and Oracle) that provide a comprehensive set of software tools across the life cycle of Information Systems solutions in support of an Information Systems Curriculum. These initiatives provide Information Systems programs with a current set of software tools that fulfill the technology requirement of accreditation, satisfy corporate recruiting needs, and do not encumber the program with a heavy financial burden or resort to substandard software tools.

Keywords: Information Systems, Information Systems Curriculum, software tools, academic initiatives

1. INTRODUCTION

One of the many challenges academic Information Systems programs (MIS, CIS, BIS, etc.) face is to keep a current portfolio of software tools in support of their Information Systems curricula. The names and descriptions of the core courses of an Information Systems curriculum have not changed much. However, due to the transient nature of software and the emergence of new software products it is hard to keep a portfolio of current software tools and technologies in support of these courses. Some of these technologies reach obsolescence in less than a year (Gorgone, 2002).

Information Systems departments and faculty have to keep up with the fast change in releases of software tools (release du-jour, web tool du-jour, web language du-jour, etc.) and the adoption of new software tools by industry (tool du-jour). Also due to the

nature and broad mission of Information Systems programs, it is compelling to ground students in emerging software technology tools and their applications. Accordingly, the introduction of new courses into the curriculum to cope with new technology trends and the set of tools in support of these courses is a requirement to keep a challenging program that is attractive to students and the industry.

Many of the software industry's leading companies have implemented programs making available their commercial software products to academic institutions for educational purposes - we refer to them as "academic initiatives". In this paper we evaluate the academic initiatives of IBM, Microsoft and the Oracle. We answer the question: "Can these initiatives provide Information Systems programs with a comprehensive set of software and productivity tools that individually or collectively cover the technology aspect of the curriculum?" In particular, can these initiatives keep the portfolio of software tools of these programs at current release levels, help equip the labs with a contemporary portfolio of software tools, and alleviate the financial burden on Information Systems program budgets? Can they also give students training and hands-on experience in the current state of software technology from industry leaders in the field?

In this paper we will present (1) an overview of the Information Systems curriculum and its software needs, (2) an overview of the three academic initiatives and their software offerings, (3) a mapping of the curriculum software needs to the academic initiatives offerings, and (4) we present the summary and conclusions of the paper.

2. INFORMATION SYSTEMS CURRICULUM

Academic Information Systems programs around the world provide a broad spectrum of emphasis. The mission of some programs is geared toward students who want to acquire knowledge of "how technology can be used, designed, and managed to support effective decision-making" (MIT-Sloan, 2007). The mission of other programs is geared toward "students who want to design and implement effective solutions to meet organizational and management needs for information and decision support" (CMU-

H&SS, 2007), while others are geared toward the development of "leaders who leverage information technology for strategic business value" (UT Austin-McComb, 2007). Although the objectives are diverse, the fundamental characteristics of a standard four-year academic Information Systems (IS) curriculum have been relatively stable. The curricula emphasize (1) a broad business and real world perspective, (2) strong analytical and critical thinking skills, (3) interpersonal, communication and team skills, (4) ethical principles, and (5) ability to design and implement information technology solutions that enhance technology performance (AISNET, 2002). Accreditation bodies emphasize the importance of (1) computing infrastructures and (2) software tools to maintain a viable Information Systems program. According to Gorgone (2003; ABET-1, 2007; ABET-2, 2007), "Laboratory and computer resources [should be] available, accessible, and adequately supported to enable students to become competent in applying current technology in solving problems."

In sections 2.1 and 2.2 we present a summary of the curriculum course sequences that intensively require software tools. Other course sequences of the curriculum that do not require software tools beyond personal productivity tools are outside the scope of this paper. In section 2.3, we provide a summary of software tools in support of the Information Systems curriculum.

2.1 Information Systems Core Curriculum: The core Information Systems curriculum is normally composed of:

- A "Fundamentals of Information Systems" course where business Information Systems and their integration across functional areas, data management, knowledge management, decision support and software development concepts are introduced. Productivity tools like MS Access and Excel and occasionally a business intelligence tool are used.

- A "Business Programming" course sequence where the fundamentals of logic and constructs of programming are emphasized. Usually one or more programming languages like Visual Basic, C, C#, COBOL or Java are taught and supported using an integrated development environment (IDE) such as Microsoft Visual Studio, Borland *Builder(s) and Delphi, Oracle

JDeveloper, Eclipse, VisualAge, Rational Software Architect, or NetBeans and its associated compilers.

- A "Data Management" course sequence where data modeling, conceptual database design, logical database design, normalization, SQL, Database administration, performance analysis, triggers, and stored procedures are covered. Usually one or more DBMS products (Access, Oracle DBMS, Microsoft SQL Server, Open Source MySQL, and IBM DB2) are used. For data modeling Microsoft Visio, IBM Rational, or other modeling tools may be included.

- An "Analysis, Design and Development" course sequence where the various aspects of the life cycle (definition, design, construction, testing and deployment) and the productive life cycle (usage and maintenance) aspects of an information system product are covered. This sequence may also include the senior project as an independent course or incorporated through out the sequence. Project management, team work, document management, source code control, milestones, deliverables and artifacts are usually emphasized. Software tools like Microsoft Project; a UML tool such as Visio Enterprise, IBM Rational, Visual Paradigm, ArgoUML; and a configuration management tool such as Team Foundation Suite, ClearCase or CVS are typically employed.

- A "Web Development" course sequence where the web computing model and protocols, web-client side development, and web-server side development are emphasized. Software technologies like the .net framework, JSP/J2EE frameworks, PHP, javascript, XHTML, CSS, XML, AJAX, ADO, JDBC, just to mention a few are frequently included. Web and application servers such as Apache/Tomcat and IIS Server provide the back-end functionality. This sequence is still emerging. It is the most diverse and transient of all the curriculum sequences. The industry has not yet converged upon a set of mature computing models in this area.

- A "Data Communication and Networking" course sequence. We will not elaborate more on this sequence, because it is fundamentally different from the others and is not within the scope of this paper.

2.2 Information Systems Extended Curriculum: Due to the nature of Information Systems programs, and to keep up with the current trends of business computing, academic programs differentiate themselves by integrating certain specializations into their curricula. The following areas that are business computing intensive and require very specialized software tools and technologies have also been included by some institutions throughout their Information Systems curricula:

- Data mining, business intelligence and decision support systems courses.

- Business processes such as supply chain management, customer relationship management and enterprise resource planning courses.

2.3 Software Tools in Support of the Curriculum: In addition to personal productivity tools (Word-processing, spreadsheet and presentation software) that are usually provided campus-wide, Information Systems programs need to equip their computer labs and provide students with specialized software tools and programming languages in support of the following areas of emphasis. Table 1 summarizes the programming language and software tools supporting each of the various emphases of the discipline:

3. SOFTWARE ACADEMIC INITIATIVES

It is a matter of survival for an Information Systems program to keep a portfolio of contemporary software tools and technologies in support of a dynamic curriculum. Managing these tools and keeping them at current release levels is a challenging task. To facilitate this task, academic institutions should consider participation in commercially available software academic initiatives which are available at a minimal cost. Oracle's and Microsoft's annual subscription fees are less than $1,000, while IBM's is free to qualifying institutions.

These initiatives provide academic programs with a wide range of tools from the top software technology companies in the industry. They also offer comprehensive and ready-to-use educational material, training (class, computer and web based training), webcasts and certifications. For the purpose of this paper, we evaluate only the software tool offerings supporting the overall Information

Systems curriculum. Although not evaluated, we recommend that academic programs take advantage of the other services offered by these academic initiatives. Based on our experience, some of the webcasts are very comprehensive and contain in-depth content. Some of the course material is very thorough and readily integrated into the course material.

In this section we provide an evaluation of the software offerings of each of the three academic initiatives mentioned previously and their coverage of the Information Systems curriculum. We do not favor one initiative over the other. Also, in this paper we do not focus on the evaluation of open source offerings and the extent of their coverage of the Information systems curriculum. We do understand that free software foundations and the open source community provide a wealth of software tools; we even use some of these tools in our program. The only exception is Eclipse, upon which the IBM Integrated development software tools are built. Accordingly, evaluating open source offerings, mapping open source offering to curriculum is beyond the scope of this paper. We only focus on the three stated commercial academic initiatives. They provide broad support to the curriculum, within reasonable budget, easy to manage and they are favored by Information Technology industry.

3.1 IBM Academic Initiative: IBM grants member accredited higher education institutions "a nonexclusive, nontransferable license to use Programs and Educational Materials solely for instructional and learning, as well as non commercial research at the Institution….. Institutions may "install copies only on: 1) …Institution's servers or personal computers … including unlimited connections so such server's to your students … 2) personal computers owned by you and your Students, …" (IBM University 2007). Table 2 is a summary of relevant software tools provided by the IBM academic initiative. A comprehensive list of the available software tools may be found at www.ibm.com/university/.

From an Information Systems program perspective, the IBM academic initiative is strong in two areas:

- The analysis, design and development sequence - it offers through the IBM Ra-

tional suite a unified process, and an "integrated" set of tools that support the requirements gathering and traceability (RequisitePro), analysis, design, construction, testing and configuration management tools (Rational software Architect, Developer, Tester, etc.).

- The data management and business intelligence sequence – it contains the DB2 set of products and tools including Intelligent Miner.

3.2 Microsoft Academic Initiative: Microsoft e-academy provides software solutions and tools "that facilitate distribution of software for educational institutes". It enables academic programs to provide students, "faculty and staff with an exclusive, campus-branded software front so that they have easy access to the software they need to excel in their programs" (Microsoft e-academy, 2007). Although the Microsoft software tools platform is proprietary, it dominates the academic, corporate and personal desktop. (NetApplications, 2007) has indicated that approximately 82% of the Operating Systems market is Windows XP (not counting Vista, 2000 and 98). Windows XP Professional is the operating system of the standard development workstation for an Information Systems student and a standard lab workstation for Information Systems programs. That is what the industry demands and that is what Information Systems programs provide. Through participation in Microsoft's e-academy, Information Systems programs have a large set of software and productivity tools that can be used in support of an academic curriculum. Table 3 summarizes the relevant software tools provided by the Microsoft academic initiative. A comprehensive list may be found at www.e-academy.com/.

From an Information Systems' program perspective, e-academy is very strong and is a necessity for those employing the Windows-Intel architecture. It provides system software and productivity tools that every student needs. As (Wells, 2006) indicated, students tend to use e-academy products beyond Information Systems course-work during their academic years.

Except for the "business processes" area of the curriculum, e-academy provides strong coverage for a typical Information Systems curriculum if an academic program chooses

to stay completely within the scope of the Microsoft platform. However, we argue that such a decision deprives students from a broader level of technical knowledge of software technologies such as the Java-Java2EE platform and server side computing beyond the Windows-Intel platform.

For those academic programs choosing to use Visual Basic or C# in their programming sequence, Microsoft's set of tools is the only choice. Also if a program decides to use the .net framework for their web development, again Microsoft is the only choice for an integrated and comprehensive web-development environment.

3.3 Oracle Academic Initiative: Oracle Academy (formerly known as Oracle Academic Initiative) offers three variations of partnerships with academic institutions to "deliver state-of-the-art Oracle software and curriculum resources to the college and university classroom. Our mission is to enable every student of higher education across the globe to acquire industry-relevant skills and an introduction to the Oracle certification pathway as part of a broader program of study" (Oracle Academy, 2007). These partnerships are typically used by:

1. "Computer science departments [to] select Oracle development, database and application server products for classroom use. This enables institutions to offer cutting-edge technology coursework for degree programs like computer science, engineering, or Information Systems".

2. "Colleges and university business schools, empowering faculty to integrate cutting-edge technology into business and computer science degree programs. Participating students are prepared for a variety of business and management roles in industries such as retail, finance, manufacturing, healthcare and telecommunications."

Table 4 is a summary of relevant software tools provided by the Oracle Academy. Http://oai.oracle.com/ provides a comprehensive list of their academic initiative software. Oracle also provides at no cost, tools outside of the academic initiative such as SQL developer and Business Intelligence. A complete list and terms of limited use are provided at:

www.oracle.com/technology/software/.
From an Information Systems program perspective, Oracle Academy is strong in two areas:

- The data management and business intelligence sequence - through the Oracle Database Management System suite of products and tools, and the data warehousing and Business Intelligence set of tools.

- Business Process, Supply Chain Management, and Enterprise Resource Planning - through the Oracle E-Business Suite and the PeopleSoft Enterprise set of tools.

4. MAPPING DISIPLINE TO SOFTWARE PRODUCTS

Information Systems programs are required to be prescient. When a student enrolls in an Information Systems program, they are not just looking for training and hands-on experience in current, in-demand technical skills. They expect their program to be broad and in-depth, and to teach meta-skills for acquiring new skills as the technology becomes obsolete or evolves. IBM, Microsoft and Oracle are among the software industry leaders in technology and software tools. They are not just providing the software tools of today, they are also researching the tools and the technologies of the future. Integrating software tools and products from multiple industry leaders has many advantages. Students are graduating with (1) employable technical skills, (2) proficiency in widely-used software tools, and finally (3) breadth and depth of knowledge beyond one computing platform.

In this section we map the different curriculum areas to the various software products of the three academic initiatives. We focus on the study of tool coverage from each of the three selected vendors. It does not attempt to score or rank the competing products. For example, should a program use IBM DB2, Microsoft SQL Server or Oracle 10g? Which IDE is better: Rational Software Architect, JDeveloper, Eclipse, NetBeans or Visual Studio? The choice is dependent on the current institutional culture, the experience and expertise of its faculty, and the demands of the labor market it serves. It is in the best interest of a program, when possible, to provide broad sets of competing technologies that use different computing

platforms and architectures for students to learn. Table 5 provides a mapping between Information Systems curriculum areas and corresponding software tools. Points to note are:

- In the business programming area, if a program decides to use Visual Basic or C#, then Microsoft is the only viable choice where academic initiatives support are provided. However, if java is used, then Oracle JDeveloper, IBM Rational Software Architect, or Eclipse are the candidate technologies.

- In the web-development area, there is no convergence on tools. If the .net framework is adopted, then Microsoft's suites and IIS server are the technology of choice. If Java-J2EE technology is used, then Eclipse, JDeveloper, or Rational are the candidate web integrated development environments. Apache/Tomcat, Oracle's Application Server, or IBM WebSphere are the candidate application servers and servlet containers.

- In the analysis, design and development area (probably the second most mature and stable area of content), depending on the depth and level of integration, a combination of Microsoft's Visio tools, and IBM Rational tools provide a good combination that runs the gamut of the development life cycle. However, Microsoft Project is probably the technology of choice for the project management aspects of the sequence. Microsoft Team Foundation Suite, or IBM Rational ClearCase are the candidate technologies for configuration management.

- In the data management area (probably the most mature and stable area of emphasis), any of the IBM DB2, Oracle 10g, or Microsoft SQL Server database management systems and tools provide a stable and mature platform. From an operational and support perspective, this area is high maintenance. A database server needs to be maintained; user accounts need to be managed; and data needs to be backed-up and archived at regular intervals.

- In the business intelligence area, IBM, Microsoft and Oracle provide stable data mining and business intelligence technologies. However, this area is usually tightly coupled with tools in the data management area. A choice in one area dictates the other.

- In the business processes area, Oracle provides a comprehensive set of tools that provides functionality in Customer Relationship Management, Supply Chain Management, and Enterprise Resource Planning.

In summary, although the three academic initiatives overlap in many areas, they collectively provide a comprehensive and broad set of software tools and utilities that cover the various aspects of a contemporary Information Systems curriculum. They provide a solid foundation to maintain a viable Information Systems program that satisfies accreditation needs. Table 5 summarizes the mapping of the three academic initiative offerings to the tool requirements of the various topic areas within the Information Systems curriculum.

5. SUMMARY AND CONCLUSIONS

During the past fifty years, the characteristics of the software tools industry (robustness, speed, homogenization, user friendliness, automation of tasks, drag-and-drop, GUI builders, etc.) have evolved beyond expectations. However, a silver-bullet to deal with the essence of how to correctly build software applications rather than dealing with their accidents has not been realized (Brooks, 1995). Accordingly, transience and rapid obsolescence are common characteristics across many of the software technology tools that support the different aspects of software product development and product life cycles.

As stated earlier, Information Systems programs have to adequately provide computing infrastructure to maintain a viable Information Systems program. At one extreme, the contents of the classic database course have changed very little (relational model, relational algebra, normalization, SQL, etc.); however, its underlying computing infrastructure (database Management system releases and version) has changed frequently in the last couple of year. At the other extreme, and with the advent of web technologies, the content of web development courses and the underlying technologies of these courses have been so tran-

sient, it is hard to predict what the trend will be one year down the road.

Through participation in academic initiatives from IBM, Microsoft and Oracle, Information Systems programs can provide both depth and breadth for a contemporary and prescient software computing infrastructure. The foundation of this infrastructure is built upon reliable and robust products from the leading software companies. These products are acquired at minimal cost and provide comprehensive support across all Information Systems curricula.

As an additional benefit, Information System programs should also explore the content and value of the webcasts and course material available as part of the academic initiative. They are high quality, in-depth, and used by these companies for the purpose of certification and within their own "for profit" training offerings.

In the Computer Information Systems program at our affiliated university, we have incorporated the IBM academic initiative (IBM University, 2007), the Microsoft academic initiative (Microsoft e-academy, 2007) and the Oracle academic initiative (Oracle Academy, 2007) into the Information Systems curriculum. This has allowed the program to stay abreast of the current state of software technology and to cope with the dynamic nature of new releases and updates. It has given the program the flexibility of shifting from one software tool to another as the market trends have demanded or as the department has seen fit. For example, in the past five years, we have been able to change, at no extra cost, the underlying language of our principles of business programming course three times (java, Visual Basic, C#) as the department has seen fit. We have also been able to change the underlying UML tools for our analysis and design course sequence (Rational Rose, Visual Paradigm for UML, IBM Rational Software Architect). In addition, we were able to provide support tools for our newly introduced data mining methods courses – again at no extra cost. Accordingly, faculty are able to focus on the content of their courses and the delivery of the content without having to worry about the availability or the quality of the underlying software tools. In the case of the data mining course and because of academic initiatives, tools From IBM, Microsoft,

Oracle, and SAS were available for faculty evaluation. Faculty were not bound by a limited number of available tools or by cost considerations when selecting the tools. Trading quality for availability or cost was not an issue (and should not have been) that faculty had to deal with.

In this paper, we have explored the viability of academic initiative offerings from the three major providers of tools for software development (IBM, Microsoft, and Oracle). We did not assess the level of deployment of these tools at academic institutions, nor did we assess institutional satisfaction. We are in the process of developing a survey to be sent to Information Systems and Computer Science programs to determine their experience, satisfaction and/or dissatisfaction with any of the three offerings. We look forward to receiving their feedback and reporting it in a future research paper on the issue.

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1.   APPENDIX: TABLES AND FIGURES

Area of Emphasis	Languages and Tools
Business Programming	• Visual Basic, C#, Java, C, C++, COBOL • Integrated Development Environments • Source Code Management Repository
Analysis & Design	• UML Tools • Project Management Tools • Requirements Engineering Tools • Document Management Repository
Web Development	• HTML/XHTML, Java Script, AJAX, XML • Perl, Python, PHP, JSP, JSF • Data access libraries (ADO, JDBC, etc.) • Web Servers, Application Servers • Web Integrated Development Tools
Data Management	• Relational DBMS(s) • DBMS Development Tools
Business Processes	• Supply Chain Management tools • Enterprise Resource Planning Tools and • Customer Relationship Management Tools
Business Intelligence	• Data Mining Tools • OLAP Processing

Table 1: Software needs per discipline

IBM Academic Initiative Software Products
WebSphere, Information Management, Lotus, and Tivoli
• Websphere Family of Products • Db2 Family of Products • DB2 Data Warehouse Edition • DB2 Intelligent Miner Modeling/Scoring/Visualization • Lotus Family of Products
IBM Rational
• Rational Application Developer • Rational RequisitePro • Rational Software Architect • Rational PurifyPlus Enterprise Edition • Rational Software Modeler • Rational Robot • Rational Systems Developer • Rational Test RealTime • Rational Functional Tester • Rational ClearQuest • Rational Manual Tester • Rational ClearCase • Rational Data Architect • Rational Web Developer • Rational Rose XDE Developer Plus • Rational Unified Process • Rational Suite Development Studio • Rational Performance Tester
Application development software
• XL C Enterprise Edition V8.0 for AIX • XL C/C++ Enterprise Edition V8.0 for AIX • XL C/C++ Advanced Edition V7.0 for Linux • XL Fortran Advanced Edition V9.1 for Linux • XL Fortran Enterprise Edition V10.1 for AIX • VisualAge COBOL Enterprise

Table 2: A Summary of IBM University Relevant Software Tools

Microsoft e-academy software Products	
Software Tools	**System Software**
• .net Framework • Microsoft Visual Studio Professional • MSDN Library • SQL Server Developer Edition • Business Intelligence Development Studio • SQL Server Analysis Services • Visio for Enterprise Architects • Team Foundation Suite • Microsoft Project Professional • Microsoft Project Server • Access 2007	• Exchange Server • Office Share Point • Share Point Designer • Vista Business • XP Professional **Productivity Tools** • Expression Web • OneNote • Visio Professional

Table 3: A Summary of Microsoft's e-academy Relevant Software tools

Oracle Academic Software Products	
Advanced Computer Science & Business	

•   Oracle 10g DBMS Family of Products
•   10giDS: Oracle Developer Suite set of Development tools
  o Oracle JDeveloper
  o Oracle Designer
  o Oracle Forms Developer
  o Oracle Software Configuration Manager
  o Oracle Reports Developer
  o Oracle Discoverer
  o Oracle Warehouse Builder
  o Oracle Business Intelligence Beans
• 10giAS: Oracle Application Server Enterprise Edition Pack	

Enterprise Business Applications & Processes	
Oracle E-Business Suite	**PeopleSoft Enterprise**
• E-Business Intelligence • Marketing and Sales • Order Management • Logistics • Procurement • Manufacturing • Service • Project • Financial • HR	• Enterprise HRMS • Enterprise Supply Chain Management • Enterprise Supply Chain Planning • Enterprise Customer Relationship Management

Table 4: A Summary of Oracle Academy Relevant Software Tools

Tool Category	IBM	Microsoft	Oracle	Comment
Fundamentals of Information Systems				
Personal productivity		Office, Visio		Open Office
Infrastructure		Windows XP, Windows Vista, Windows Server 2003		Linux
Business Programming				
Language Compiler	XL C, C++, COBOL	Visual Basic, C, C++, C#		Java SDK – integrated in IBM and Oracle IDEs
IDE	Software Architect VisualAge	Visual Studio	JDeveloper	Eclipse, NetBeans
Analysis and Design				
Modeling	Rational Architect	Visio, Vision for Enterprise Architect		ArgoUML
Project Mgt		MS Project		
Requirements Mgt	Rational RequisitePro			
Process	Rational Unified Process			
Web Development				
Client side	WebSphere	Visual Studio, .Net, Internet Explorer	Developer Suite	Firefox, Eclipse, NetBeans
Server side	WebSphere	Visual Studio, .Net	Developer Suite	Eclipse, NetBeans
Web/App Server	WebSphere	IIS, Windows Server 2003	App Server EE	Apache/Tomcat
Data Management				
DBMS	DB2	SQL Server	Oracle 10g	MySQL
Business Processes				
SCM, ERP, CRM			E-Business Suite, PeopleSoft Enterprise	
Business Intelligence				
Data Mining	DB2 DataMiner	BI Development Studio, SQL Server Analysis Services	BI Suite	

Table 5: Discipline-Software tools