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In this issue:

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Abstract: Nothing is more important in the IT world than having the right skill sets in the right time. Recent advances in e-Commerce technologies draw a lot of attention from both industry and academia. The former is looking for the people with the skill set that can be applicable immediately and the latter is trying to meet those needs. However, the rapid changes in e-Commerce technologies and the inertia in academia to reflect these changes curriculum-wide, make the industry's need hard to be met. Industry is always concerned in keeping up with new technologies for the fear of getting left behind. On the other hand, the programs offered in academic institutions seem to always be behind. In this paper, we compare current e-Commerce technologies with the existing e-Commerce graduate programs in the US, thus factually identifying the apparent gap between academia and industry. With our suggested e-Commerce graduate program, we propose a solution that attempts to bridge this gap.

Keywords: e-Commerce curriculum, e-Commerce graduate programs, e-Business application software

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Bridging the Technological Gap between Academia and Industry: Towards a Successful e-Commerce Graduate Program

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Abstract

Nothing is more important in the IT world than having the right skill sets in the right time. Recent advances in e-Commerce technologies draw a lot of attention from both industry and academia. The former is looking for the people with the skill set that can be applicable immediately and the latter is trying to meet those needs. However, the rapid changes in e-Commerce technologies and the inertia in academia to reflect these changes curriculum-wide, make the industry's need hard to be met. Industry is always concerned in keeping up with new technologies for the fear of getting left behind. On the other hand, the programs offered in academic institutions seem to always be behind. In this paper, we compare current e-Commerce technologies with the existing e-Commerce graduate programs in the US, thus factually identifying the apparent gap between academia and industry. With our suggested e-Commerce graduate program, we propose a solution that attempts to bridge this gap.

Keywords: e-Commerce curriculum, e-Commerce graduate programs, e-Business application software

1. INTRODUCTION

It is a common belief that e-Commerce plays a major role for most of the companies worldwide, in their efforts to survive and gain competitive advantage in the digital economy. For many of the companies, this is still a new way of doing business and a paradigm shift is necessary prior to implementing any e-Commerce initiatives.

E-Commerce is not just buyer-side or seller-side packaged application. It goes far beyond than traditional commerce applications that simply allow buying and selling of products/services. Its applications include supply-chain management, vendor management, online catalog management, customer relationship management (CRM), order management, marketing and advertisement (Fingar, 2000).

There have been numerous e-Commerce applications available on the market to meet those needs. However, many companies still use legacy applications, company specific enterprise resource planning (ERP) systems and client/server systems as their internal system for doing business. There have to be some interface mechanism that provides interfaces for those applications to the outside world. As more companies adopt e-Commerce as their preferred way of doing business and as more vendors provide various e-Commerce related software products on the market, interoperability among different applications and establishment of the standards are becoming key issues. As vendors are busy pumping out the products on the market, companies are struggling to recruit experienced personnel who can develop and maintain their e-Commerce systems using these rapidly changing technologies. History shows that technologically

savvy companies have a better chance of survival in the global market.

However, finding the right person with the right knowledge at the right time is a difficult task for the industry. The knowledge from academia is rarely up-to-date and it takes a decent amount of time and effort to boost up employee's knowledge to the needed level.

In the United States, many colleges and universities are currently offering a variety of e-Commerce related programs that normally concentrate on either the technical, managerial, and/or ethical aspects of e-Commerce. Even though these programs try to cover what is necessary for the industry, it is always students' responsibility to fill in the blanks of the program to make his/her skill-set complete.

In this paper, we are proposing a comprehensive e-Commerce curriculum that follows the current directions of e-Commerce. The paper is organized as follows. Section 2 surveys the currently available e-Commerce technologies. Section 3 overviews the current academia status of this discipline. Section 4 proposes the curriculum that attempts to bridge the gap between industry and academia. In the final section we conclude the paper with remarks on our findings.

2. E-COMMERCE TRENDS IN INDUSTRY

Retail e-Commerce sales in the forth quarter of 2003 was about $11.921 billion and this figure is 4.4 % up from the fourth quarter of 2002 (www.census.gov, 2003). Figure 2.1 shows the growth of the e-Commerce retails from U.S. Census Bureau between 4th quarter of 1999 and the 1st quarter of 2003. To support this growth, many e-Commerce related software products were developed and used in the entire e-commerce supply chain activities (Linthicum, 2001). However, due to the large number of the software products, it is not easy to choose the right software for a company. Many new e-Commerce software products have been introduced and disappeared in relatively short period of time. This dynamic change of software continues to cause confusion in academia when software education is concerned. To identify the trends and interrelationship among e-Commerce related soft

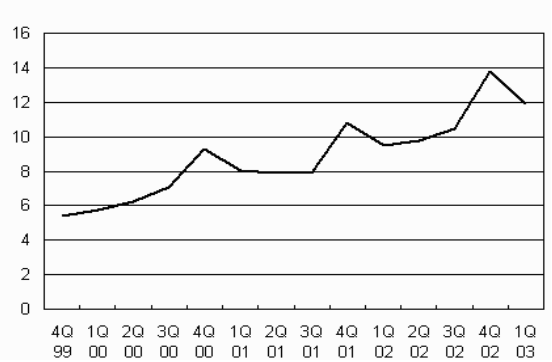

Figure 2.1 Estimated Quarterly U.S. Retail E-commerce Sales: 4th Quarter 1999 - 1st Quarter 2003 (in billions of dollars)

ware, several categorization of the software came about (Linthicum, 2001)(Robertson et al., 2002)(Ge et al., 2000). Inspired by previous software categorizations (Linthicum , 2001)(Ge et al., 2000), we attempt to identify the technologies and commercial software products used in recent e-Commerce area. Due to the complexity and amount of the work, we would like to cover only the major ones. Some of the software products do not clearly fall into single category. Rather, they span over several categories. The categories we use in this paper, and whose main features we discuss, are:

1. e-Business Application Software,
2. Middleware,
3. Web Servers,
4. Database Management Systems, and
5. e-Commerce Interoperability Standards.

2.1 E-BUSINESS APPLICATION SOFTWARE

e-Business application software is software that uses the Internet or other electronic medium for business transactions and services. A typical example of application software is an electronic catalog that works as an interface between business and customer (B2C) or business and business (B2B) between applications. During business transactions, the middleware hides the complexity of the underlying operating system and network and allows information exchange on be half of the application programs (Linthicum, 2001).

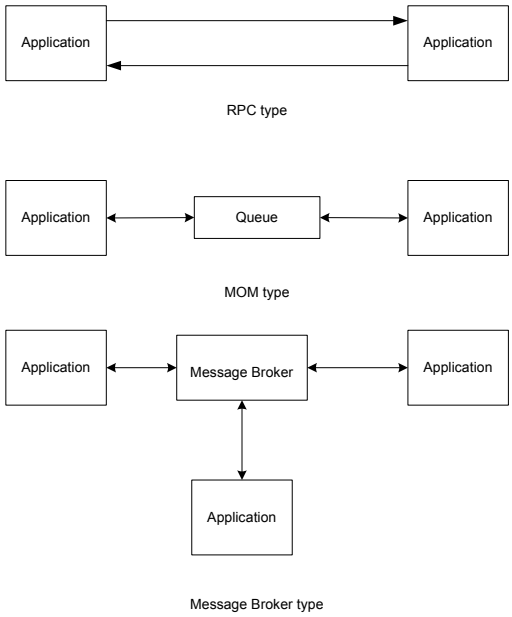

Figure 2.2 Message Broker Types

2.2 MIDDLEWARE

Middleware is a mechanism to move information and shared business logic. There are three types of middleware according to the types of communication. These types are Remote Procedure Calls (RPC) type, Message oriented message (MOM) type, and Message Broker type (Figure 2.2).

The RPCs connect applications point-to-point by using a simple pipe to allow one application to link to another application. A direct link or links must be maintained during messaging service for message synchronization. In contrast, the MOM type uses a queue between two parties so parties don't need to maintain a point-to-point connection. However the two parties must connect by a specified queue. In message broker type middleware, multiple parties can participate in transactions and message services asynchronously. This type of brokers has following advantages: it works with B2B application servers, distributed objects and intelligent agents. Distributed objects allow B2B application to create portable objects that run on a variety of servers, objects that communicate using predefined messaging interface over the Internet. And the degree of B2B application integration is very high. Adding to those benefits, message brokers facilitate information movement between two or more resources and can account for differences in application semantics and platforms by using common rules and routing engines.

Some products do not clearly fall into one of these categories. For example, TP Monitors are application servers as well as transactional middleware products. They provide a mechanism for communications between two or more applications. Application servers provide not only sharing and processing of application logic, but also connections to back-end resources like databases, ERP applications, etc. A selected list of middleware is in Table 2.1.

Name	***Type***	***Company***
Distributed Computing Environment (DCE)	RPC	The Open Group
MSMQ	MOM	Microsoft
MQSeries	MOM	IBM
CORBA	Message broker	OMG
RMI	Message broker	JavaSoft

Table 2.1 Middleware Examples

One of the popular middleware solutions in e-Business is SAP R/3.

SAP R/3

SAP AG has developed the business DP (Data Processing) system R/3 that is a three-tier distributed model. R/3 is realized as a multi-level client-server system with the components of a database server (MVS, UNIX, Windows NT), multiple application servers (UNIX, Windows NT), and several presentation servers (Windows NT, UNIX). R/3 also has modules that can build up business models. Its business functionalities can be summarized as follows (Slama, 1999):

- Client capability
- Scalability and parameterability by customizing
- Integrated authorization system

- Complete separation of the user-view from the DP-view
- SAP workflow between modules to handle business processes
- Process modeling with the ARIS toolkit
- Secure mass data import (migration) using batch input
- Executive information systems
- Coupling of external systems (archive, CAD)
- R/3 industry solutions, such as for banks, insurance companies, hospitals, and energy supply utilities.

2.3 WEB SERVERS

The main functions of a web server are receiving requests from the clients, forwarding the received requests to the appropriate applications if necessary, and send back the results to the client. Typical web server provides service of large number of documents including HTML, Common Gateway Interface (CGI) for server side applications, API (Application Programming Interface) for server side programming, and Managing Secure Socket Layer (SSL).

Some of the popular web servers are Apache HTTP Server, MS IIS, MS Commerce Server, MS BizTalk Server, IBM @server, and Jakarta Tomcat.

2.4 DATABASE MANAGEMENT SYSTEMS

Database Management Systems (DBMS) are an important component of the e-Commerce related systems. Data oriented B2B applications heavily depend on access to databases. Database-orientated middleware layer helps data access any number of databases regardless of their platform. The access is generally accomplished through interfaces such as ODBC (Open Database Connectivity) or JDBC (Java Database Connectivity). Some examples of database interfaces are following:

- Open Database Connectivity (ODBC) is a standard that Microsoft created. ODBC simplifies database access from Windows by allowing that a single API call.
- Application Programming Interfaces (APIs) is a set of procedures that can be called from outside the application to get it to do something.
- Java Database Connectivity (JDBC), from JavaSoft, is functionally similar to ODBC. JDBC provides Java developers with a uniform interface to most popular relational databases.
- Adaptable Database (Adabas) provides a high-performance database environment primarily for mainframes. One powerful functional characteristics of Adabas it that it provides a nested relational structure.
- Object Linking and Embedding Database (OLE DB) is a specification that defines a set of data access servers capable of linking to multiple data sources. OLE DB uses a standard COM interface to grant access to data.

2.5 E-COMMERCE INTEROPERABILITY STANDARDS

B2B interoperability standards involve description of message formats exchanged, relationships to transport protocols, and other features, such as security (Dogac, 2002). Selected examples of standards are listed in Table 2.2.

As we have discussed in this survey, there are numerous technologies related to e-Commerce, but none of these dominates the whole market. The e-Commerce technologies go through continuous changes as the demands from the users change. The current trends in e-Commerce are the distributed approaches and the use of middleware protocols, which means that the major portion of the e-Commerce transaction processing is done by distributed objects or components using networked computers. The burden of interfacing legacy applications is also distributed objects' responsibility. Many organizations are adopting the concept of component repository for component reuse and ease of maintenance to reduce the development cost and to meet the time to market constraints. The communication between business entities or between processes is getting faster and more efficient thanks to middleware technologies and standard data format such as XML.

Table 2.2 Examples of Standards

Name	Description
XML (eXtensible Markup Language)	XML is a standardized way of representing structured data as text files. It uses markup tags to denote a block of text like HTML (Hyper Text Markup Language). XML has only contents without presentation and it is an interchange format, as well as an extensible format. This framework is used as a base content format in many current e-Commerce software.
Electronic Data Interchange (EDI)	Historically, EDI is the best-known e-Commerce application. Originally created for linking together the business partners in the transportation industry, EDI has become a common tool for many organizations working with their suppliers and partners. A typical example of EDI is sharing data such as order and payment.
Common Object Request Broker Architecture (CORBA)	CORBA is a standard mechanism to share application services both within and between applications by OMG (Object Management Group). It provides a powerful framework for accomplishing building and implementing software system across the enterprise. And CORBA is also an object-based distributed middleware that is based on the idea of an Object Request Broker (ORB). CORBA combines two important trends in the computer industry: object-oriented software development and client/server computing. The CORBA facilities offer standardized approaches to solving domain-specific problems.
Distributed Component Object Model (DCOM)	DCOM allows developers to create automation servers and make them available for other COM-enabled B2B applications on the network. DCOM is not commercial ORB (Object Request Broker), but a part of the operating system (NT 4.0, Windows 98 and Windows 2000). With DCOM, the COM-enabled application checks the registry of the Windows operating system to locate and use remote COM-enabled ORBs, finding and calling the service it requires.
Remote Method Invocation (RMI)	RMI is a product of JavaSoft and it is a simple synchronous mechanism that allows applets to communicate with one another and invoke each other's methods as needed. RMI provides an easy-to-use approach to distributed computing, but does not support the advanced architectural features of COIRBA-compliant ORBs.
Component Object Model (COM+)	COM+ is a new version of COM. It uses OLE (Object Linking and Embedding) model as its basis of design. COM is also based on automation, is a standard on most Windows desktops and a feature of most Windows-based development tools.
Simple Object Access Protocol (SOAP)	SOAP is an XML-based protocol for invoking RPCs. It uses a method-invocation mechanism where return values are carried as HTTP requests and responses, allowing the protocol to operate even through firewalls.
ebXML (electronic business XML)	ebXML consists of a group of related specifications that are maintained by the United Nations Center for Trade Facilitation and Electronic Business (UN/CEFACT, the overseers of EDI) and OASIS. ebXML provides means for companies to integrate their processes easily. EDI provides business communication tools with more complicated and higher priced than XML. XML, as a platform-independent language, has multiple usages than simple data exchange between companies. Exam registries hold information on potential trading partners in the form of Collaboration Protocol Profiles (CPPs). CPPs are XML documents that use a specific vocabulary to identify business processes that a company is willing and able to take part in, the roles that it can play, and technical information about its capabilities.
RosettaNet	RosettaNet is an independent, self-funded, non-profit consortium dedicated to the development of XML-based standard e-Commerce interfaces. The consortium includes IBM, Microsoft, EDS, Netscape, Oracle, SAP, Cisco Systems, Compaq and Intel. Its framework consists of Partner Interface Processes (PIPs), a master dictionary and RosettaNet implementation framework (RNIF) (Dogac, 2002).

In order to design these rapidly changing and distributed systems, component-based approach should be employed since:

- The development time is reduced by assembling the components,
- The components are loosely coupled with each other since they may come from different vendors, and
- The components communicate through message passing, which reduces dependencies among the components.

To design systems that comply with these requirements, the industry has adopted a new design standard – the Unified Modeling Language (UML), which provides object-oriented design methodology. It has been proven to be effective and also the most widely accepted design methodology.

3. STATE OF ACADEMIA

The e-Commerce, in colloquial terms, studies the principles underlying the development process of doing business online. This section overviews our findings on the state of academia with respect to existing graduate programs in e-Commerce, and closely related areas.

3. 1. E-COMMERCE AND RELATED DISCIPLINES

It is imperative that existing programs in e-Commerce respond to the state of technology and the demands of the industry. Setting up a stable base and working foundation to this discipline is more than a critical task and may have many unpredictable side effects if not approached carefully.

With the boom of the industrial trend of doing business online in the convenience and wealth of the global village, the academic programs related to e-Commerce witnessed a fast development in the late 1990's. Due to the enormous scope of e-Commerce, and the need for diversified personnel to support it, many schools came up with quick fixes to this demand. In the pilot programs many schools decided to offer certificate programs that heavily relied on the technical and other skills covered in a given related undergraduate program, and would quickly vertically develop skills in relation to one or several aspects of e-Commerce.

There has not been a unique agreement, nor model in the past or the present followed by the majority of the programs in e-Commerce. The goal of this section is to give an overview of the flavors of various solutions of master level programs in e-Commerce, and give a framework for comparison. Together with the comments on the industry needs, this section will lay grounds for proposing a unified graduate program in e-Commerce that would serve a wide range of demand, and cover the needs of e-Commerce, which, although with recession trends in the national and global economy, still shows a high need for well trained specialists.

Figure 3.1 gives an overview of several related disciplines with respect to their coverage of systems topics. The Computer Science programs study the principles underlying the development process of computing systems. CIS programs emphasis the intricacy involved in large-scale information systems development and management. IT programs train the students to be able to facilitate the environment for implementation of technology, whereas IS programs stress on the environment for system development and maintenance. MIS programs emphasize the oversight of IS/IT used in Decision Making.

Depending on the flavor of the program offered, the e-Commerce programs are being called a wide range of names. The ones that are most frequently used are e-Commerce, for programs of mixed management and industry flavor, e-Business, for the managerial ones, and Web Programming for programs that concentrate on the technological aspects of e-Commerce. The technology-flavor programs seem to offer the greatest range of "titles", such as Web Development, and even Internet Engineering. The inconsistencies in the names, again, are due to the age of the discipline of e-Commerce, which is still in its inceptions, and there is not a widely agreed definition of what the term means. Indeed, they are similar, and technically most of the times e-Business is cited as superset of the

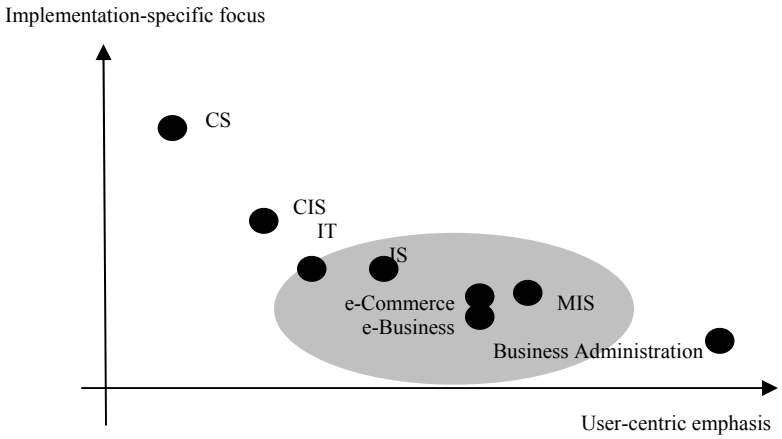

Figure 3.1. The classification of foci of various related curricula from the systems perspective. The gray area represents the area of interest of this paper.

e-Commerce, but there are some authors who disagree on this.

3.2. OVERVIEW OF EXISTING MASTER PROGRAMS IN E-COMMERCE

The approaches in setting the graduate e-Commerce curricula vary considerably by school. A strategy appropriate for one school may not fit the overall goals and objectives of another school. The current graduate programs in e-Commerce fall into one or several of the following three categories:

1. Predominantly management-oriented programs
2. Predominantly technology-oriented programs
3. Predominantly ethics and legal issues oriented programs

The word "predominantly" in the above classification is used purposely, because we do not believe that there can be a program that falls into one category only, due to the multidisciplinary characteristics of the discipline.

The first category of programs is traditionally offered as stand-alone tracks in graduate business schools. They emphasize the business side of the coin, and stress on doing business on the Internet, without going into details on the technological perspective of the topic. Basic web programming skills are usually taught as a part of the curriculum.

The technology-oriented graduate programs, offered under the auspices of departments that house computer science, or computer engineering, concentrate on the programming aspects of doing e-Business, without going into details on management side when topics on gaining competitive advantage on doing business in the Internet are concerned. The legally oriented programs are almost a rarity, and are seldom offered as stand-alone programs. They concentrate on the legal, ethical, societal, and international issues concerning the global e-Commerce.

Most programs that are currently being offered consist of a mixture of courses from all the three categories. Based on the schools that offer them, they lean towards the management side, or the technological side in one way or another. After covering the core materials that reflect the flavor of the program, students choose a number of elective courses that serve their goals and needs.

As hard as figuring out the technical details on products, packages, and platforms used in the industry, it is learning what of those should be taught in detail or case studies in the graduate programs. The catalogues that are publicly available, don't reveal details on

the programming languages and packages that are used as a base for instructional development. The course descriptions are kept vague, and without technological details. Due to the rapid development and sudden and frequent changes in the e-Business, i.e., its technology, specifying these details is contra productive to leaning process. Due to the standard procedures that are in place in the schools, vague and technology-specifications-free descriptions offer space for adjusting the courses to the future needs, and abilities of the instructional force.

E-Commerce programs are young, and still calibrating to the needs of the students, where most of the input comes from. In order to keep up with the needs of the industry, on one hand, and the lack of qualified instructors on the other, schools often opt to hire part-time faculty (who works full-time in the industry) to teach more advanced courses.

Table 3.1. is intended to give a global look at the state of academia at present. Presented are 30 graduate programs with major e-Commerce programs with diverse flavors of coverage.

Regardless of those problems in the study, it is a general conclusion that currently most schools choose to have an intensive JAVA training early in the program. Most schools have decided to call this part of the program "JAVA Boot camp". Afterwards, the other courses take the students deeper in the disciplines of focus. No particular commonalities have been noticed across all the programs surveyed.

Table 3.1. Summary of 30 existing e-Commerce and related graduate programs in US, chosen based on the availability of information. (M: management, T: technology, L: ethics, legal. The numbers refer to credit hours.)

UNIVERSITY		COMPULSORY				ELECTIVES				SCHOOL or COLLEGE	MS/MBA
		#	M	T	L	#	M	T	L		
[8]	Loyola University of Chicago	3	M			15	M			School of Business	MBA
[9]	Barrington University	12	M								
[10]	Carnegie Mellon Institute for E-Commerce	20		T		6	M	T			MS
[11]	Creighton University	9		T		11		T		College of Business Administration	MS
[12]	Dalhousie University	7	M	T	L	21	M	T	L	multiple schools	MS
[13]	DePaul University	9		T		26		T		School of Computer Science, Telecommunications and Information Systems	MS
[14]	North Carolina State University	1	M			11				College of Management & College of Engineering	MBA
[15]	University of Illinois at Chicago									College of Business Administration	MBA
[16]	The Wharton School University of Pennsylvania	4	M			32	M	T		Multiple schools	MBA
[17]	Owen Graduate School of Management at Vanderbilt	5	M			16	M			School of Management	MBA
[18]	Duquesne University	6	M			1	M			School of Business Administration	MBA/MS
[19]	Stevens Institute of Technology	12	M			3	M			School of Technology Management	MS
[20]	University of Washington	2	M			7	M			School of Business	MBA

[21]	RMIT University	11		T		1		T		School of Computer Science & Information Technology	
[22]	Regent University					4	M			School of Business	MBA
[23]	Barry University Andreas School of Business		M							School of Business	MS
[24]	Capitol College	12	M				M				MS
[25]	Drexel University	7	M							College of Business	MBA
[26]	Golden Gate University	7		T		22		T		School of Technology & Industry	MS
[27]	Mercy College	6	M			4	M				MS
[28]	Metropolitan College of New York	16	M			8	M	T	L	School of Business	MBA/MS
[29]	National University	12	M							School of Business & Information Management	
[30]	Notre Dame De Namur University	10	M							School of Business & Management	MS
[31]	San Francisco State University	7	M			5	M			College of Business	MBA
[32]	Temple University The Fox School of Business and Management	2	M			2	M			School of Business & Management	MBA
[33]	University of Advancing Technology									College of Technology Commerce	MS
[34]	University of Maryland University College	9	M			1	M				MS/MBA
[35]	University of Wisconsin-Milwaukee	8	M			9	M			School of Business Administration	MS
[36]	University of Washington	4	M							School of Business Administration	MBA
[37]	Stuart School of Business	8	M			11	M			School of Business	MBA

3.3. THE ISSUES OF ACADEMIA IN E-COMMERCE EDUCATION

What is the role of the academia has been a burning question for a long time, especially in courses/programs that are of more technical nature, such as the one we are discussing. How deep into the academic and how deep into the "vocational" part should the program go?

There are two solutions to this problem. The first one is a quick fix, more suitable for the certificate programs, where the academia is just teaching technical skills that the (usually local) industry needs at the time. But, for a degree program, it is necessary to make sure that a certain level of theoretical basis are covered, so that the trainees are not bound only to the current state of the art at the time the course has been offered. Not only the tool, but also the principles on which the tools have been built, as well as alternative existing and potential solutions must be overviewed. The project part of the courses need to be exploring deeper into the principles, rather than heavily relying on sterile application development on existing platforms, wherever possible and appropriate.

This type of program requires quite a bit of planning and commitment, especially in the logistics area. The obstacles that are usually encountered in the implementation of this program are discussed in this section. Lack of *clear vision* is an obstacle that needs to be overcome by the designer of the courses, especially while setting the goals and the scope of the courses. If the vision is missing, there will be a *lack of leadership*, and a di-

minished support and participation by senior administration. It is critical to know the state of the disciplines at the institution, and to design the courses to satisfy the current mission and goals of the program.

The implementation of a stand-alone program is likely to be supported by administration, faculty and the industry. When proposing the courses and the whole program, examples of existing successful courses in engineering schools are normally a sufficient argument to gain support in introducing such courses in the evolving curriculum. If the school is inflexible to changes, problems resulting from this should be anticipated, and a strategy for addressing them based on past experience should be developed accordingly.

New courses that have not yet been established in the curriculum provide the instructors with the flexibility in meeting the current needs and teaching approaches. Since each section of the course offered has its own personality, it is imperative that the instructor keeps the course opened for modifications and on-the-run adjustments to keep up with the technological state of the art in the discipline taught. The courses should be general enough to allow the instructor to infuse topics on the current developments in the areas. As the students begin to engage in the class activities, or choose their topics for individual article critique, or research paper, the instructor may get the sense of dominating topics of interest by the student audience, which should trigger him/her to supplement the course with additional reading materials.

The question of the number and the size of projects given within courses is another important issue in the setting the program. As it usually happens, one semester is too short for students to complete a comprehensive project of academic value. They need more time to get the full understanding of what the domain of e-Commerce requires and to get familiar with the different roles in the e-Commerce world. Therefore it is crucial that the committee that is designing the program and the instructors involved in teaching the courses for the program (normally in the same team), sit together and come up with a project that students can work on across several courses. Based on the culture of the school, the quality and needs of students, the question of whether the projects should be individual or team projects, and whether the program should have a capstone course should be carefully discussed and examined before reaching any consensus.

4. SUGGESTED CURRICULUM

With the survey in the previous sections, we have discussed the current technologies for building and maintaining efficient e-Commerce sites and the e-Commerce programs currently available in the US.

Although there are model curricula to be followed, (www.washington.edu, 2003), they do not fit well with our intentions, because they are IS-focused, neglecting the technical aspect of Computer Science.

One of the challenging tasks in e-Commerce software industry is that it has to meet continuously changing requirements from their industry users as quickly as possible. Several solutions can be considered in that regards including incremental development life cycle that can be achieved by prioritized and iterative component-based development or evolving from existing applications. Even though strategic decisions such as rewrite or evolution should be done in collaboration with other domain expert, once the decision is made, e-Commerce programmers should be ready for the current technologies and development processes to implement the decision. To be able to cope with such situation, e-Commerce application developers should understand and proficient with not only technological side of it but also with management side such as Internet supply chain management for fundamental domain knowledge.

Our suggested curriculum attempts to apply such components into the curriculum so that any student who mastered the program can be able to handle such situations. We categorize required skill sets into several areas – Networking for e-Commerce, Web Programming, Distributed Systems on the Internet, XML Technology, Web Engineering, the Internet Supply Chain, and the Ethical Issues in E-Commerce.

Table 4.1. The modules of our suggested curriculum for a graduate program in e_Commerce.

Area	Major Topics
Managerial Challenges in e-Commerce	e-Business models (B2B, B2C) Internet file management Supporting the information architecture. Databases. Payment systems. Transformational aspects of e-Business and new business models. Financial implications for e-Business. Cost/benefit, business plans and the need for venture capital.
Networking for E-commerce	Frames and Packets, IP, TCP, UDP Interconnection devices: hubs, switches, routers IP addressing – IP addressing, subnetting, and classless addressing Routing of IP packets WWW and mobile IP DNS Socket interface Multicasting and multicasting routing protocol Network management Network/Internet security
Distributed systems in the Internet	Clients and Servers Middleware CORBA, COM/DCOM, and RMI Database server and Distributed Database Transaction processing
XML technology for E-commerce	XML fundamentals XML parsers – SAX, DOM, Xerces XML-RPC, SOAP XML security ebXML
Internet supply chain management	Value chain Supply chain Planning and design e-Commerce supply chain
Web programming	HTML/DHTML ASP.Net JSP/Java
Web application design methodology	Life-cycle models UML fundamentals Software requirements analysis Functional/ non-functional requirements Use cases Data flow diagrams State transition diagrams/ Sequence diagrams Web navigation diagram Software architecture Client/server Distributed Database schema design User Interface (accessibility) Design Software testing Software maintenance
Legal, Ethical and Societal issues in e-Commerce	Privacy and property issues in e-Business Federal, State and International laws Web accessibility

The suggested contents for each topic are given in Table 4.1. The curriculum topics above are organized in eight modules (courses), which correspond to the traditional organization of graduate studies in most schools, where space equivalent to two courses is left for electives.

When designing the courses in details and choosing the topics to be covered in details, no team should focus on the state-of –the-art technologies, and the emerging technologies, but must also make sure that sufficient space is left to cover the appropriate theory, underlying principles and concepts. As suggested in Gorgone et al. (1999), graduates should have obtained a decided-upon level of skills and knowledge. Although this is not an IS-only-focused program that we are proposing, in the spirit of the MSIS 2000 suggestions (Gorgone et al., 1999) by the end of the program, students will have

1. A core of e-Business knowledge, across the managerial, technical and ethical/legal aspects
2. Integrated knowledge of technological and business principles
3. Broad business and real world perspectives
4. Communication, interpersonal and team skills (values)
5. Analytical and critical thinking skills
6. Specific skills leading to a career (professional degree).

5. CONCLUSIONS

E-Commerce software development requires an orchestra of modern computer technologies and is also facing the following challenges:

- rapidly evolving E-commerce markets with frequently proposed new standards
- demanding customers with ill-defined requirements (inadequate e-Commerce business plan and volatile tech environment)
- requirements that manage both product software development and project software development (customer specific applications) simultaneously

In this paper we proposed a blueprint for an e-Commerce graduate program that best suits the current industrial needs. We identified the discrepancies in the academic institutions profile outputs and the needs of the e-Business employers. Our proposed curriculum is flexible enough to embrace the ongoing changes in the cyberspace, but yet, is based on cutting-edge technological and managerial perspectives. Its legal/ethical component can and should change as the legalities in this domain change.

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