TECHNICAL FOUNDATIONS OF E-COMMERCE CURRICULUMS: AN EXPLORATION OF THE IMPORTANCE, CONTENT, AND EXTENT OF TOPICS

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Abstract

Realizing that the Internet has changed the way business is conducted, many business schools have designed, or are in the process of designing, e-commerce courses and developing an e-commerce curriculum. Because e-commerce is based on technology, many institutions are dealing with the technical issues of the technology. To assist educators with program design, this research examines the importance, content, extent and sequencing of e-commerce technology courses in the curriculum. Utilizing a web based survey, the opinions of IS educators are examined, summarized, and directions for future research are presented.

Keywords: E-commerce, IS education, IS curriculum

Introduction

E-business /e-commerce curriculums, both independent majors and tracks within other majors, are being offered with increasing frequency in academic institutions. Many different topics are being offered within these programs dealing with many aspects of the business process. One topic area that appears to be underemphasized in these programs is the technical complexity of operationalizing and implementing the three tier client server environment required to support a dynamically interactive web site, which most businesses ultimately adopt (Reselman 2000). Three major factors appear to be influencing this under emphasis. First, it is relatively easy to create a static web site using GUI design tools, such as FrontPage or Dreamweaver, focusing on the visual aspects of the site and ignoring the technical issues. Second, there is no clear path identified by any standards agency (such as WC3 for client side technologies) that lays out the desirable technical structure of a three tier web site. And third, the technologies for developing a three tier web site are technical, complex, rapidly evolving and newly emerging. The purpose of this paper is to focus on the technology issue of e-commerce and, if included in an IS curriculum, what should be included in the foundation courses. We are not addressing the issues related to the rationale behind, or the structure of, an e-commerce/e-business curriculum. These results will provide direction and guidance to those who are beginning to address the technical aspects of ecommerce within their course offerings.

We first discuss the importance of the technical foundation for an e-commerce curriculum. After the importance of this topic is established we then briefly outline the three tier web environment and the predominant technical options of each tier. Utilizing this model a survey is developed and implemented. The results of the survey will be presented and analyzed. Finally, the implications will be discussed and the limitations of the current study will be discussed along with suggestions for future studies.

The Issue of a Technical Foundation

The Internet quickly changed the face of education with 25% of US MBA programs offering an e-commerce major by Spring of 2001 (Keenan 2001). This growth, however, was followed by the dot com bust. The sudden change produced mixed results as

academics were faced with the realization that e-commerce is now a part of the business landscape and it must be part of the curriculum, but it is no longer viewed with the enthusiasm from students that it received in the previous years. Colleges and universities have struggled to determine the proper way to implement the fundamentals of e-commerce into the curriculum (James 2000; Alsop 2001). While some schools have scaled back their e-commerce efforts, or reframed them within more traditional disciplines, many schools continue to press forward with e-commerce initiatives (Alsop 2001).

In addition to the impact of e-commerce on fundamental business practices, academics are also struggling with the amount and nature of e-commerce technology that is appropriate. Companies have sited the need for IT graduates to have more e-commerce training and complain that by the time the training is offered it is six months behind the technology (Landeriault 2000). Curriculum issues are coming to the forefront as educators try to balance the technical skills with the business skills. No longer are Computer Science majors sticking exclusively to programming and Business majors sticking to business plans. Schools are integrating the two to create employees who can add value to their organizations. Students in business schools are often involved in utilizing technology to create solutions to business needs (Seminerio 2001). While this appears simple on the surface, teaching the latest technology along with sound business practices is a difficult problem. Some schools are creating a "skills" based curriculum to address a business demand (Dillich 2000), while others are integrating technology into existing curriculum (Alsop 2001). This technology struggle is clearly stated by Northwestern Professor Tom Collinger: "If you fall in love with the technology or with a particular application of the technology, it may blind you to the fundamental framework which is guiding it (James 2000)."

Examining the issue from the marketing perspective, Mitchell and Strauss (2001) identified the major requirements of an e-commerce curriculum from the academic and practitioner perspectives. In this study they determined that the elements of the three tier model are necessary components of an e-commerce curriculum, but they did not examine the specific technologies and balance needed. Their identification of the autonomous nature of the technological aspects of an e-commerce curriculum establishes the basis for the objectives of our research.

Three Tier Model of E-Commerce Technology

As businesses evolve into fully integrated ecommerce organizations, the demands on their web sites rapidly progress beyond the capability of being supported by a site built from static web pages. Customers, suppliers, partners and employees quickly reach the point of requiring an up-to-date response with the information customized and personalized to meet each request. These web applications are typically three-tier distributed applications. Tier 1 is the user interface implemented on the client computer using a web browser. Tier 2 is the business logic installed on a server that includes a web server and business applications. Tier 3 is the data storage and retrieval controlled by a database management system. (Deitel, et. al., 2002 p.891)

A conceptual model of this dynamic environment is shown in Figure 1 (adapted from Reselman 2000, p. 19). Each component of the model interacts with the other components to enable real-time processing and responses to requests for information. Each of the three components and the primary technologies associated with each will be examined in the following sections. The definitions used to explain these technologies have been adapted from Webopedia (2002), an online resource for definitions and operational explanations of Web technologies.

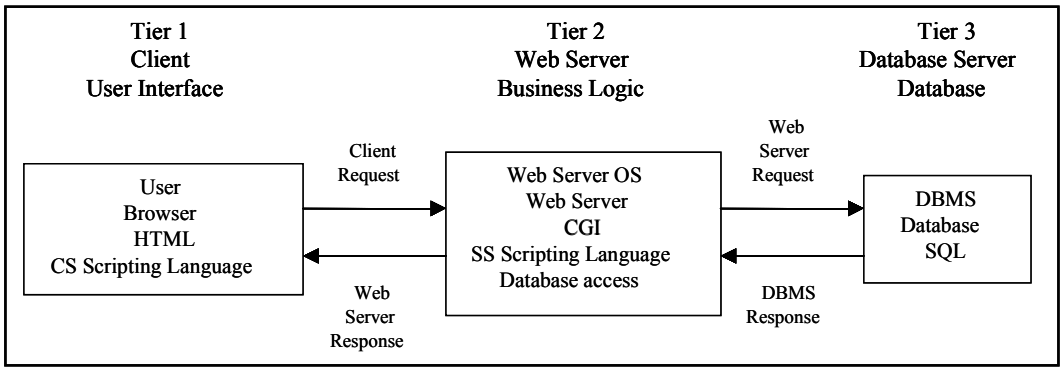

Figure 1. Three-Tier Distributed Web Application

Tier1: Client Side

The processing on the client side mediates the user's contact with a web site. The primary program on the client is the browser, which handles the data input from the user, including URL requests and transaction data, along with communication tasks to the server. Interaction with the server is accomplished through hyperlinks that submit requests for a different URL and forms that collect information from the user and submit it to the server for processing.

Table 1. Primary Client Side Technologies

Topic	Description
Web Browser	A software application used to locate and display Web pages. The two most popular browsers are Netscape Navigator and Microsoft Internet Explorer. This program can run scripts on the client that enhance the interaction with the user.
HTML	Short for *HyperText Markup Language,* the authoring language used to create documents on the World Wide Web. This language is interpreted by the browser which creates the text and graphics we see displayed on the computer monitor.
EMCA-262	A universal browser scripting language developed by the W3C to enable Web authors to design web pages that can interact with the HTML source code and create dynamic content. The two primary, although incomplete, implementations of this language are JavaScript, created by Netscape, and Jscript, created by Microsoft.
XML	Short for *eXtensible Markup Language,* a new specification developed by the W3C that allows Web authors to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

Tier 2: Server Side

The web server receives requests from the client for information stored on the server or accessed by programs running on the server. The primary program on the web site is the web server application. This program manages and responds to each request from every client, which can be as many as several thousand concurrent requests. For static pages, the web server locates and retrieves the requested page and then sends it back to the requesting client. For requests that include data and dynamic requests, special languages are used to receive the client request from the Internet, process the submitted data, build the appropriate response, and return the dynamically created page to the requesting client. The primary server side technologies are described in Table 2.

Tier 3: Database

The DBMS, often on its own server, receives requests from the web server for information stored within its database. The requested data is collected and returned to the web server. These requests are generally formulated using SQL in conjunction with special program commands available in the language of the requesting program. One of the benefits of high level server side languages is that they contain built in data access features that make the data easy to obtain and readily available for processing to meet the client's request. The primary database technologies are described in Table 3.

Survey Development

In selecting the items to be included as topics for the questionnaire, the authors used the objectives set out in the preparation guides for the CWI certification exam (CIW 2002) and the i Net+ certification exam (i-Net+ 2002). We also used our own experience in teaching, researching and consulting on ecommerce issues. Because we wished to collect the opinions of academics teaching or researching in the ecommerce area, we decided to use a web-based survey to reach our target population. We believe that the shortcomings of web-based surveys, which were identified by O'Malley, et al., (2002) as demographics, technology capability, and literacy capability of the subject, appear to be non factors in this survey given the subject matter and the target population. When presenting their paper (O'Malley, et al. 2002), the researchers noted that some subjects could not complete a longer survey in one session. As a result, subjects would either not take the survey or have the session terminate (thereby

corrupting the instrument) before they could resume the survey following an interruption. To overcome this limitation to our web based survey, we structured our final instrument so that it would take less than 10 minutes to complete. To visually promote completion of the survey, interactive color cues are used to convey the completion progress of the respondent. A copy of the survey is presented in the Appendix.

Table 2. Primary Server Side Technologies

Topic	Description
Web Server	A computer connected to the Internet (or a compatible network) with an installed Web server application. Every Web server has an IP address and possibly a domain name. The two most popular operating system families for web servers are Unix/Linux and Windows NT/2000.
Web Server Software	A software application on a web server that delivers (*serves up*) Web pages requested by a client. There are many Web server software applications, including public domain software from NCSA and Apache, and commercial packages from Microsoft, Netscape and others.
CGI	Abbreviation of *Common Gateway Interface*, a specification for transferring information between a Web server and a program. running on the server
Server Side Low Level Languages	Programming languages that run outside the web server application on the web server. Program developers must write code that conforms to the CGI specifications in order to receive data from the web server application and return manually constructed web pages to it. PERL and Java are examples of these languages.
PERL	Short for *Practical Extraction and Report Language,* Perl is a programming language developed by Larry Wall, especially designed for processing text. Because of its strong text processing abilities, Perl has become one of the most popular languages for writing scripts that use the CGI protocol.
Java	Java is a general purpose programming language with a number of features that make the language well suited for use on the World Wide Web. Small Java applications are called Java applets and can be downloaded from a Web server and run on your computer by a Java-compatible Web browser, such as Netscape Navigator or Microsoft Internet Explorer. It is also used for writing scripts that use the CGI protocol.
Server Side High Level Languages	These are scripting languages imbedded within HTML pages so that the programmer can switch between HTML and the scripting language and avoid having to manually generate the HTML code. The CGI interaction is built into these scripting languages so the code is much less complicated. These languages have built in capabilities to facilitate interacting with a wide variety of databases. ASP, PHP, and ColdFusion are examples of these languages
ASP	Short for *Active Server Pages,* a server-side, HTML embedded scripting language used to create dynamic Web pages. In an HTML document, ASP script (usually VB Script) is enclosed within special ASP tags. Because ASP is embedded within tags, the author can jump between HTML and ASP instead of having to rely on heavy amounts of code to output HTML. ASP can perform any task any CGI program can do using built in features, but its strength lies in its compatibility with many types of databases. ASP is a proprietary programming environment that only runs on Microsoft's Internet Information Server with a NT/windows 2000 operating system.
PHP	Short for *Hypertext PreProcessor,* a server-side, HTML embedded scripting language used to create dynamic Web pages. In an HTML document, PHP script is enclosed within special PHP tags. Because PHP is embedded within tags, the author can jump between HTML and PHP instead of having to rely on heavy amounts of code to output HTML. PHP can perform any task any CGI program can do using built in features, but its strength lies in its compatibility with many types of databases. PHP is an open source programming environment that is usually run on Apache web severs with a unix/linux operating system.
ColdFusion	A proprietary product that includes a web server application and a development toolset designed to integrate databases and Web pages. Cold Fusion Web pages include tags written in Cold Fusion Markup Language (CFML) that simplify integration with databases and avoid the use of more complex languages like Java to create translating programs. While ColdFusion is a proprietary product, it runs on both major web server operating system families.

Table 3. Primary Database Technologies

Topic	Description
Database Server	A computer connected to a network that is a dedicated host for a DBMS.
DBMS	Short for *Database Management System (DBMS),* an application that accesses information from a database. This is a collection of programs that enables you to enter, organize, and select data in a database.
Database	A collection of information organized, stored and accessed in such a way that a user's request can quickly retrieve desired pieces of data.
SQL	Short for *Structured Query Language*, a standardized query language for requesting information from a database. It is supported by most DBMSs and is independent of whether the DBMS is hosted on a PC, workstation, minicomputer or mainframe.

An email inviting the recipient to participate in this survey was distributed by the ISWorld listserve to its approximately 1600 subscribers. The members of this list are academics and other professionals who are interested in information systems. A similar email solicitation was sent to the 100 participants and authors of the Southern Association of Information Systems 2002 Conference with the additional request that they forward the solicitation to any colleagues they think might have an interest in the topic. The conference attendees are academics and other professionals who are interested in information systems.

Upon release of this survey and review of the initial comments (from respondents and reviewers) it was determined that the survey was more complex than initially thought, so a simpler survey with a reduced scope was produced. The first survey is available at http://itom4.cob.appstate.edu/ect/old and the revised survey is available at http://itom4.cob.appstate.edu/ect. The revised survey was easier to complete and assessed many of the same areas that the initial survey addressed, but in a simpler manner.

Presentation and Discussion

Simple descriptive statistics provide insights into the topics that academics find important. A summary of the demographics of the respondents are presented in Tables 4 - 7.

Table 4. Respondent Demographics - Location

Location	Responses	
North America	49	74%
South America	0	0%
Europe	7	11%
Africa	2	3%
Asia	3	5%
Australia/New Zealand	5	8%

Table 5. Respondent Demographics - Position

Position	Responses	
Full Professor	9	14%
Associate Professor	18	27%
Assistant Professor	24	36%
Other Faculty	2	3%
Ph.D./Graduate Student	10	15%
IS Web Professional	0	0%
Other IS Professional	0	0%
Non-IS Professional	0	0%
Other	3	5%

Table 6. Respondent Demographics – Organization Type

Organization	Responses	
Doctoral/Research University	26	39%
Master's College/University	32	48%
Baccalaureate College	6	9%
Associate's College	0	0%
Specialized Institution	0	0%
Private Research Organization	0	0%
Government Institution	0	0%
Private Organization	1	2%
Other	0	0%

Table 7. Respondent Demographics – E-commerce Offerings

Institutional E-commerce Course Offerings		
	Responses	
Basic	14	23%
Advanced	35	61%

As is indicated by the previous tables, the respondents were primarily from North America with all other continents represented except South America. Assistant Professor were the largest single academic group represented, but all but three of the respondents were at academic institutions with a representation of all ranks. Respondents were from mostly academic institutions with good representation from all levels of 4 year institutions.

Table 8. Frequency Analysis – Client Side Technologies

	Response Categories None				Heavy		Whole Course			
	0	**1**	**2**	**3**	**4**	**5**	**6**	**Avg**	**Responses**	**No Opinion**
HTML	0 0%	13 21%	14 23%	17 27%	13 21%	5 8%	0 0%	2.7	62	6 9%
Web Design Tools	0 0%	4 6%	18 29%	21 34%	11 18%	8 13%	0 0%	3	62	6 9%
Web Site Design	0 0%	5 8%	10 17%	18 30%	16 27%	11 18%	0 0%	3.3	60	8 12%
JavaScript	0 0%	2 4%	11 20%	31 55%	8 14%	4 7%	0 0%	3	56	12 18%
DHTML	2 4%	7 13%	19 36%	15 28%	7 13%	3 6%	0 0%	2.5	53	15 22%
XML	0 0%	3 5%	10 18%	20 36%	13 24%	9 16%	0 0%	3.3	55	13 19%
CSS	2 4%	10 19%	12 23%	16 31%	10 19%	2 4%	0 0%	2.5	52	16 24%

While no definitive conclusions should be drawn from these data, the data does suggest that some client-side topics are of greater importance than others. Web site design and XML had the highest average response followed by web design tools and JavaScript. It is interesting to note that HTML was just slightly ahead of DHTML and CSS. While there are differences in importance, there is no indication that any of these technologies should be left out. This might indicate that with tools capable of automating web site development readily available, less emphasis needs to be placed on the some of the more fundamental technologies. Furthermore, with the greater importance placed on XML, site design, and JavaScript it would appear that more emphasis is placed on the usability of a web site as opposed to the technical issues of site construction.

Table 9 presents the data on server side technologies. Java, Active Server Pages and SQL appear to be the most important technologies and in concert could offer a complete package for server side development. From this data it is evident that the higher level issues of interactive site development appear to be more prominent. In addition to Active Server Pages, Java Server Page and PHP received moderate support. The technical structures such as the Operating Systems and the web server applications appear to be of lesser importance. The basic constructor languages such as Perl are minimally supported.

Table 9. Frequency Analysis – Server Side Technologies

	Response Categories None				Heavy		Whole Class			
	0	**1**	**2**	**3**	**4**	**5**	**6**	**Avg**	**Responses**	**No Opinion**
Active Server Pages	1 2%	4 7%	8 15%	24 44%	15 27%	3 5%	0 0%	3	55	13 19%
PHP	2 5%	7 18%	8 21%	9 24%	10 26%	2 5%	0 0%	2.6	38	30 44%
Cold Fusion	5 11%	14 31%	14 31%	3 7%	7 16%	2 4%	0 0%	2	45	23 34%
Java Server Pages	1 2%	7 15%	15 31%	12 25%	11 23%	2 4%	0 0%	2.6	48	20 29%
Perl	5 11%	16 34%	13 28%	7 15%	4 9%	2 4%	0 0%	1.9	47	21 31%
Java	1 2%	7 15%	10 22%	9 20%	9 20%	10 22%	0 0%	3	46	22 32%
VBScript	3 5%	11 20%	12 21%	16 29%	13 23%	1 2%	0 0%	2.5	56	12 18%
Java Servlets	2 4%	10 20%	12 24%	15 31%	8 16%	2 4%	0 0%	2.5	49	19 28%
Microsoft IIS	3 7%	7 15%	17 37%	7 15%	11 24%	1 2%	0 0%	2.4	46	22 32%
Apache	3 7%	7 16%	12 28%	8 19%	10 23%	3 7%	0 0%	2.6	43	25 37%
Windows 2000/XP	3 6%	9 17%	20 37%	9 17%	12 22%	1 2%	0 0%	2.4	54	14 21%
Unix/Linix	4 9%	6 13%	15 32%	7 15%	12 26%	3 6%	0 0%	2.6	47	21 31%
SQL	3 6%	3 6%	9 17%	8 15%	16 30%	15 28%	0 0%	3.4	54	14 21%
ActiveX Data Object	4 8%	5 10%	16 32%	16 32%	7 14%	2 4%	0 0%	2.5	50	18 26%
ODBC	2 4%	6 11%	14 26%	15 28%	12 22%	5 9%	0 0%	2.8	54	14 21%

The data presented in the previous tables is reinforced by the open comments received from the respondents. A selection of these comments is presented in Table 10 and indicates that the issue is still evolving with different institutions taking different approaches. The comments also indicate the issues that faculty members deal with as well as the importance of this issue.

Table 10. Pertinent Respondent Comments

While EC technologies are important, we tend to over-focus on tech issues and neglect two important areas: - the use of such technologies (HCI/customer focus) - the integration and systems perspective (what we want them for and how EC architectures are supported by the technology infrastructures). We teach almost all these technologies, at both levels. But we do not run an E-Commerce course, nor do we integrate them into any meaningful architecture/systems course. This is a shame, because students leave with a fixation on the mechanics of technology, rather than the use of technology.
When I teach the ecommerce technology courses, I choose one platform to focus on (either ASP/Microsoft IIS, JSP/Apache or Cold Fusion). I mention the other but all lab work is done using the chosen platform, which we change depending on the course. We are also in the process of installing the .Net platform and plan to do some work with .Net ASP.
Our e-commerce material is integrated in a topics class. Admittedly, the degree of complexity of the course is dictated by who is teaching it and their bent and expertise. We want to do more, but we are restricted from adding new courses as we go through accreditation.
While the e-commerce bubble has burst the topic remains important with a focus on integration.
Our design course is strictly project oriented and all of the projects are related to web design and basic use of asp. Some other technical issues are covered in the database and networking class. We have to technology-driven e-commerce class.
The final section dealing with platforms does not make sense in this questionnaire. They are _all_ valid and required platforms, one is not more important than another. Should a university offer courses dealing in all of the platforms? Probably not, just like industry more often than not, runs their e-Commerce system on multiple platforms. The knowledge gained on one platform can be leveraged across other platforms, as the basis of each web server, database server and application server is essentially the same. So I only answered the SQL and ODBC (assuming you meant to include JDBC [not otherwise listed]) question, as it is universal across all platforms. Perhaps the question should have been asked: "Web server like IIS or Apache"; or "a specific operating system, such as Windows 2K or Linux or Unix" This philosophy could actually be applied to the upper sections too, dealing with scripting languages or web page authoring. The choice of language usually follows the platform selected or available to teach on. What is really missing is the XML manipulation capabilities, especially XSLT and XPath. Also, the survey should ask opinions on whether commercial packages are advisable to be included in the e-Commerce curriculum.
If the course is business focused then the technology underpinnings must be there of course, but only at a high level understanding and with direction as to where to find out more detail in the students own time if they are so inclined. This is my view of an EC course and I've answered accordingly Alternatively, if the course is a technical course then the focus must be heavily instructional.
Basic platform issues are important at the outset. Do you want to go Microsoft or "Open" (Evil Empire or Evil Federation)? What's available to you and what's your department budget like? The tools can be complex, and it becomes tempting to teach the tool rather than the underlying theory, and the students will encourage this approach. Primarily, I would run this questionnaire by your industry council, if you have one, and give their opinions a lot of weight but would also strongly consider faculty abilities and opinions. Good luck.

Conclusion, Limitations and Future Directions

From the simple analysis of the data and the extensive comments it is evident that many different opinions exist as to what technologies should be taught and the extent to which they should be taught. Our final survey did not ask respondents to indicate the technology that is available at each institution and it is possible that faculty opinions are influenced by the technology that is available at their institution as well and technologies with which they are most familiar.

The results of this study begin to offer insights into the complex issue of integrating technology into an e-commerce curriculum or even an IS curriculum and are clearly not definitive. Perhaps it was best summarized by one interested respondent who stated: “Let us discuss this topic sometime as I have been struggling with it. Perhaps we can help each other.” This exploratory study is simply an attempt to begin the dialogue and this should not be the last time that technology in the curriculum should be

discussed. E-commerce is an evolving business medium and schools should continually monitor its development while seeking to integrate the concepts in ways that are appropriate for enrolled students and potential employers.

Future studies should examine the new programs specifically in e-commerce and contrast the technologies utilized in these curriculums with the technologies in the traditional IS programs. As traditional programs begin to incorporate e-commerce technologies there is a chance that the line between the two will quickly blur or they may continue to coexist. Future studies should also address the effectiveness of teaching a particular technology product as opposed to teaching the concepts independent of a specific technology.

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