

A Reference Model for Designing a Curriculum for E-commerce

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1. Introduction

E-business is a process that provides Internet-based support for buying and selling goods, services, and digital information, generating demand for them through marketing and advertising and through sales and customer service. Business-to-business (B2B) revenue is projected to rise from \$43 billion in 1998 to \$1 trillion in 2003, a 23-fold increase. Consumer purchases online are expected to be worth \$380 billion in 2003, up from an estimated \$31.2 billion in 1999. According to a recent study by the University of Texas Center for Research in Electronic Commerce (<http://cism.bus.utexas.edu/>), the Internet economy in the U.S. generated a combined revenue of \$301 billion and was responsible for 1.2 million jobs in 1998. It is interesting to note that the Internet economy has already surpassed traditional sectors such as energy (\$223 billion) and telecommunications (\$270 billion) and is comparable with the automobile sector (\$350 billion). The growth in e-commerce activities has been phenomenal and is expected to increase even further.

We present in this article a reference model for understanding and discussing e-commerce issues. This model is structured into three sub-models: business model level, customer behavior model, and IT resource model. We discuss the challenges that still lie ahead and address training and education for e-commerce in more detail. We provide a proposal for a graduate program in E-commerce based on this reference model.

2. A Reference Model for E-commerce

We propose a reference model for e-commerce, as a way to structure the analysis and discussions about e-commerce systems. This model consists of three sub-models, as indicated in Figure 1. The top level model is the *business model*. It describes aspects such as

- Type of business: this includes e-tailers, auction sites, B2B, e-malls, and vertical and functional hubs for B2B interactions.
- Type of products: some sites sell physical products that need to be shipped (e.g., books, CDs, computers), others sell digital products (e.g., reports, journal articles, audio files, software) that are delivered over the Internet,

while other sites sell services (e.g., online trading of securities, insurance brokerage, and home and car financing).

- Revenue-generating model: this aspect of the business model determines how an e-commerce site obtains revenue from its activity. In some cases, the revenue comes from direct sales of the products, in others from subscriptions, and in other cases from advertisement).
- Business policies: at the business level there are several policies of interest, including product return policies, privacy policies (e.g., how does a site treat information such as who bought what and when), pricing, and intellectual property considerations.

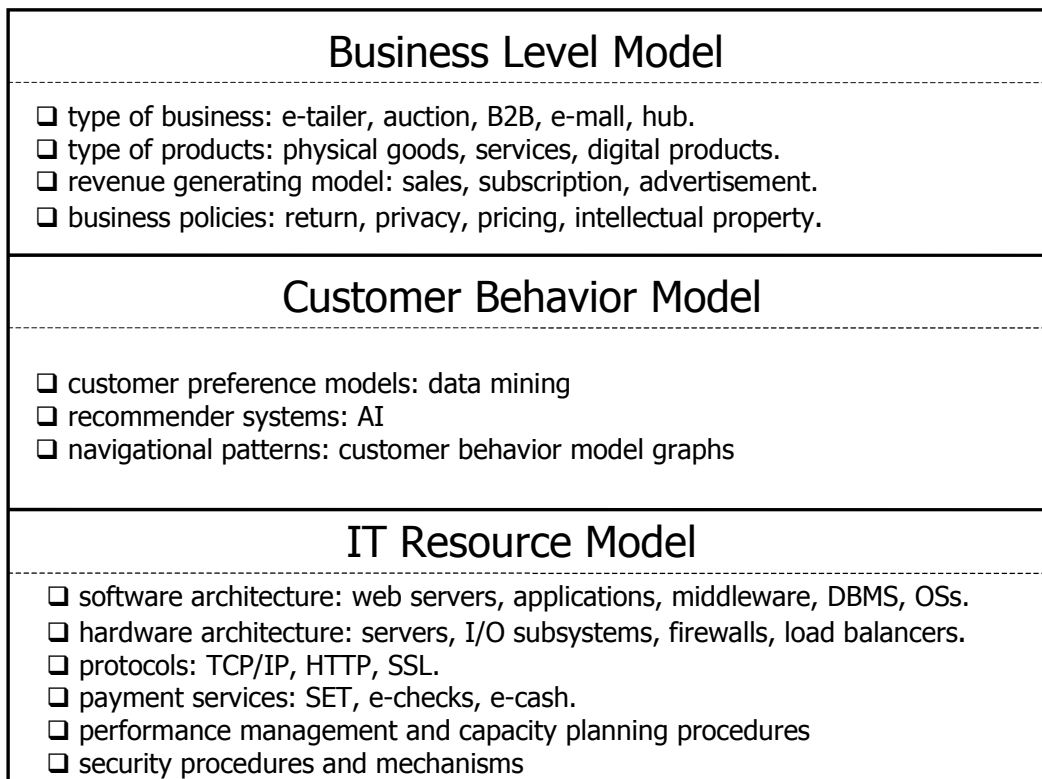


Figure 1 - E-commerce reference model.

The business level model determines what and how an e-commerce site offers to its customers. At the next level of the reference model, we need to understand and model how customers use and interact with an e-commerce site. The *customer behavior model* deals with issues such as:

- Customer preferences: through the use of customer tracking (e.g., through cookies) combined with data mining techniques, e-businesses can create customer profiles to customize content and tailor advertising to a customers' preferences.

- Recommender systems: there is already technology available to match a consumer with her "digital soulmate" in large databases of buying profiles. Recommender systems are able to suggest to a customer, with a significant degree of success, what products she may be interested based on the profile of her digital soulmate.
- Navigational patterns: a sequence of consecutive requests to an e-commerce site coming from the same customer is called a session. The navigational patterns within a session can be captured in graphs such as the Customer Behavior Model Graph (CBMG) [MAFM99]. The nodes of a CBMG represent functions of an e-commerce site (e.g., browse, search, add to shopping cart, pay). The transitions between these nodes are labeled with the probabilities that a customer moves from one node to the other during the session. These graphs can be used to obtain metrics such as average number of visits to nodes of the graph, average session length, and buy to visit ratio. Other interesting relationships can be derived as well. For example, it was shown in [MAFM99], that for a particular e-tailer, the buy to visit ratio decreases with the square of the session length.

The next layer of the reference model is associated with the IT resources needed to support the e-business activities. Components of the *IT resource model* include:

- Software architecture: this includes the various software servers (e.g., http servers, application, and database servers), middleware, and operating systems.
- Hardware architecture: includes the boxes, I/O subsystems, crypto accelerators, firewalls, routers, and load balancers that comprise the site.
- Protocols and network topology: the hardware elements of an e-business site are connected through various local area networks and through wide area networks in the case of distributed e-business sites. The connectivity of a site to an ISP is an important element of the site's networking topology. Another important element is the set of protocols used by the site. These include the mandatory TCP/IP and HTTP, but may also include Secure Sockets Layer (SSL) or S-HTTP in support of authentication.
- Payment services: various types of payment services may be supported by an e-commerce site. Some examples include Secure Electronic Transactions (SET) for credit card payments, digital checks, and e-cash.
- Performance management and capacity planning procedures: a site's performance is an important consideration in e-business. Sites that exhibit poor performance, in terms of response time and/or availability, tend to lose customers to other sites or to brick and mortar stores. Thus, an important

element of the IT resource model is the set of procedures for performance management and capacity planning used by the site.

- Security procedures and mechanisms: in e-business, security is fundamental to the operation of the site. There are various aspects of security that need to be managed: mutual authentication of the parties involved in e-business transactions, protection of the confidentiality of customers' information (e.g., credit card numbers), protection of a site's resources (e.g., servers and backend mainframes) from unauthorized use, and protection against denial of service attacks.

3. Challenges in E-commerce

E-commerce has been a big success already, but challenges still lie ahead. We discuss here some of these challenges in light of the reference model described in the previous section.

3.1 Challenges at the business level

At the business level, the challenges include legal, taxation, pricing, and privacy issues. Legal issues include the determination of the jurisdiction of an e-commerce transaction. Suppose a customer in Hong Kong buys a computer from an e-tailer headquartered in San Francisco, California, and the computer delivered to the customer does not work as advertised. The customer complains but the merchant does not believe any action should be taken. A dispute arises and needs to be sorted out in a court of law. Which court? In San Francisco? In Hong Kong? The first option favors the merchant while the second favors the customer.

Another legal issue in electronic transactions has to do with contract negotiation. This is particularly important in dynamic B2B market places, in which contracts are negotiated through the Internet by special software agents using machine readable languages to specify the business rules of a contract [GLC99]. These contracts have to be digitally signed and the parties have to be mutually authenticated. Even though a digital signature is much harder to forge than a physical signature applied to a paper contract, digital signatures are not yet widely accepted in most courts. Eventually, the legislation will catch up with technology.

Pricing strategies are very important in dynamic markets such as the ones characterized by auctions. E-business sites could potentially launch robots to probe the price of its most important competitors before displaying a price when requested by a customer [GKT99]. This process should be fast enough to avoid elongating too much the response time perceived by the customer. So, a site may not wait for all the answers before making a decision. A discussion on pricing strategies can be found in [BFDMKD99, Odlyzko99]. Pricing is also an important

element when an e-business site sells bundles of items as opposed to single items [Parkes99].

Privacy is another important consideration. Few sites post privacy statements. These statements tend to be long and complex and are seldom read or understood by users. A recent development has the potential for solving this problem. It is the Platform for Privacy Preferences Project (P3P) by the World-Wide Web Consortium (W3C) [RC99,WC3]. The basic idea behind P3P is that a Web site sends the browser a machine-readable privacy statement. The browser, or a browser plug-in, can then parse the privacy statement and compare it with the privacy preferences set by the user. Good tools are needed at the browser level for setting and managing privacy preference as well as alerting users of privacy policy mismatches [ACR99].

3.2 Challenges at the Customer Behavior Level

At the customer behavior level, better and more efficient techniques are needed to enhance the customer's shopping experience at an e-commerce site. This includes dynamic customization based on past history and current navigational pattern, and adaptive and transparent adjustment of the resolution of objects presented to users to adapt to their bandwidth resources. For example, if a user is accessing an e-commerce site from a low bandwidth personal digital assistant (PDA), the site should send summarized text-only descriptions of catalog items, while if the customer is coming from a high bandwidth connection, colored pictures and more extensive descriptions may be displayed. Another interesting development is the use of software agents in e-commerce [MGM99]. Agents can alert customers, based on their profile, about the availability of an item they are interested at the price range they specified. Recommender agents can suggest customers what to buy [SKR99].

3.3 Challenges at the IT Resource Level

Users typically become impatient and take their business elsewhere after eight seconds of waiting for a page to download. This rule has been known in the industry as the *eight-second rule*. When a user clicks out of a site, sales may be lost. Experimental evidence has shown that a mere increase of one second above the eight-second threshold may increase the click-out rate from 8% to 30%. Bad performance may scare prospective buyers during a single visit or may lead them to avoid a site altogether. The economic impacts of bad performance in e-commerce are not to be overlooked.

The GVV Center at Georgia Institute of Technology publishes World Wide Web (WWW) user surveys twice a year (www.cc.gatech.edu/surveys). In the October 1998 survey, users were asked the main cause of their dissatisfaction when they

were buying on the Web. Eighteen percent of the surveyed customers indicated that slowness was the main cause for the bad experience, surpassing poor page design as the leading cause of dissatisfaction.

In April 1999, Zona Research, Inc. (www.zonaresearch.com) conducted a study of the economic impacts of unacceptable Web-site download speeds. The researchers concluded that \$4.35 billion in sales are lost each year in the United States because of unacceptable download times. A previous user survey conducted by Zona Research reported on customer behavior during the 1998 holiday season. This study showed that over one-third of the customers simply gave up buying an item when faced with site slowness. Another 44% of the customers turned to brick-and-mortar stores and paper catalogs. Only 14% moved to another Web store.

The estimated annual losses in potential sales must be weighed against expenditures in software, hardware, and bandwidth that help improve performance.

Performance problems tend to get worse as the number of wireless PDAs increases and as new interfaces, such as voice user interfaces (VUIs) (see www.generalmagic.com) to e-commerce sites become more prevalent. These interfaces will allow people to access e-commerce sites in many different new situations. For example, one could imagine someone driving a car and being alerted through a voice interface that certain stocks in his portfolio are down 10%. The user could then hold a session with the online trading site using its VUI. These factors will increase the load and bandwidth requirements on e-commerce sites. Also, as more agents get deployed, e-commerce sites will see the number of requests increase.

Performance management and capacity planning will be extremely necessary to overcome these challenges [MA98, MA2000].

4. Existing Courses in E-commerce

Many universities already offer programs in E-commerce. These programs vary from specializations/concentrations in traditional programs (e.g., MBA with concentration in e-commerce) to new graduate degrees in e-commerce. In some cases, the programs are completely hosted in a single school (e.g., school of business) and in other cases they are offered by more than one school or unit (e.g., school of business and computer science department). Some of the schools/universities offering graduate programs in e-commerce are: Bentley College (Graduate School of Business), University of California at Berkeley (CS and Haas School), Carnegie Mellon University, Columbia University, Copenhagen Business School, Duke University-Fuqua, Emory University, Georgia State University, Hong Kong University, University of Maryland at College Park (R. H. Smith School of Business), University of Maryland, Baltimore County, University of Michigan, Ann Arbor, University of North Carolina (Flagler School), University of Pennsylvania

(Wharton School), Penn State University, Rutgers University, Newark, University of Texas, Austin, Vanderbilt University (Owen Graduate School). We provide below an overview of the approaches taken by three of these offerings.

The Robert H. Smith School of Business at the University of Maryland, College Park, offers a cross functional concentration on E-commerce in its MBA program that cuts across the more traditional areas in the business school such as logistics, marketing, operations, international business, finance, and information systems (www.ibm.com/iac/frank-electronic.pdf). Some of the courses in the e-commerce program include Technology and Business Models for E-commerce, Electronic Channels of Distribution, Telecommunications and Technology Policy, Telecommunications and Computer Networks, and Real-time Management of Supply Chains

Carnegie-Mellon University offers a Master of Science in Electronic Commerce. Students must take 23 one-quarter courses (www.ecom.cmu.edu). Half of the eighteen required courses come from the Graduate School of Industrial Administration (business courses) and the other half are e-commerce oriented courses offered by the School of Computer Science (technology courses). This leaves five electives. The required business courses are: introduction to e-commerce, managerial economics, financial accounting, marketing fundamentals, applied data analysis, Internet marketing, finance, supply chain management, competitive strategy, and e-commerce law and regulation. Some of the business electives are: marketing research, price, order fulfillment, and managing customer service businesses. The required technology courses are: e-commerce technology, web programming, communications and networks, the Internet, information retrieval, electronic payment systems, computer security, multimedia technology, system reliability, and human computer interaction. Technology electives include databases, data mining, electronic negotiation, intelligent agents, web architecture, and Java programming among others.

Georgia State University has created the eCommerce Institute as part of the J. Mack Robinson College of Business (<http://cis.gsu.edu/digicomm/>). This institute offers an executive e-MBA and a regular e-MBA. The program is organized around two international seminars and five mini-mesters (two per academic year semester). Courses include e-marketing, e-infrastructure, e-accounting, e-Economics, e-Decisioning, e-Finance, e-Supply Chain, e-Technology Applications, e-Change, e-Strategy, e-Security and Payment Systems, e-Policy, and e-Law.

5. Designing a Curriculum for E-commerce

An analysis of the various graduate degrees offered in e-commerce shows that some are well balanced between technology and business and others are more skewed towards one side of the issue. We advocate the need to build a curriculum

that cuts across the three levels of the reference model presented in section 2 and provides a balance across the levels and not necessarily between business and technology.

An embodiment of our proposal is shown in Figure 2. Within each level, a set of core courses has to be taken and two electives from each level have to be selected for a total of 23 half-semester courses. Some of the courses in our proposal already exist in CS departments (e.g., networking, security, databases, and performance evaluation) and in business schools (e.g., marketing, financing, and supply chain management), while some others would have to be created (e.g., recommender systems, pricing on the Internet, and e-advertisement). In some cases, some of these topics may already be covered as part of other courses. A repackaging would be needed.

A description of each of the courses shown in Figure 2 is outside the scope of this article. We rely on the titles to convey the idea of what should be covered in each course. It should be pointed out that an orientation towards e-commerce should be given in all courses. For example, the course on marketing should cover the basic fundamentals in marketing and then show how the Internet has added a new dimension to marketing.

	CORE	ELECTIVES (select two at each level)
B U S I N E S S M O D E L	<input type="checkbox"/> The information economy <input type="checkbox"/> E-commerce business models <input type="checkbox"/> Marketing <input type="checkbox"/> Law for E-commerce <input type="checkbox"/> Pricing on the Internet <input type="checkbox"/> Supply chain management	<input type="checkbox"/> Financing <input type="checkbox"/> Distribution channels <input type="checkbox"/> Order Fulfillment <input type="checkbox"/> Taxation <input type="checkbox"/> Accounting
C B U S I N E S S M O D E L O V E R L A P I N G	<input type="checkbox"/> Recommender systems <input type="checkbox"/> Workload characterization <input type="checkbox"/> Data mining <input type="checkbox"/> Statistical data analysis	<input type="checkbox"/> Human Factors <input type="checkbox"/> Marketing research <input type="checkbox"/> E-advertisement
I T R E S O U R C E M O D E L	<input type="checkbox"/> Networking <input type="checkbox"/> Security <input type="checkbox"/> E-commerce sites software architectures. <input type="checkbox"/> E-commerce sites hardware architectures <input type="checkbox"/> Performance evaluation <input type="checkbox"/> Payment Systems <input type="checkbox"/> Human Computer Interaction	<input type="checkbox"/> Advanced Networking <input type="checkbox"/> Software agents <input type="checkbox"/> Databases <input type="checkbox"/> C/S systems and middleware <input type="checkbox"/> Multimedia <input type="checkbox"/> Advanced Security

Figure 2 - A proposal for a curriculum for e-commerce.

A program such as the one described here requires a certain level of maturity and experience from entering students. We would suggest that candidates should have graduated from college with a degree in business or computer science and should have a minimum of 3 years of relevant working experience before being admitted to such a program.

6. Concluding Remarks

With the continued growth of e-commerce, it will be necessary to have more and more people with the necessary skills to understand all aspects e-commerce. Very shortly, most companies will be participating in e-commerce in one way or the other. We presented here a reference model to discuss e-commerce issues and applied it to the design of a curriculum for a graduate degree in e-commerce. We believe that such curricula should strive to achieve a balance across the levels of the reference model as opposed to a balance between business and technology. While our proposal is not intended to be a complete and detailed curriculum, we hope it will serve as a useful guide to institutions that want to design their own graduate programs in e-commerce.

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