A reference model for designing an e-commerce curriculum

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The e-commerce revolution has arrived. E-commerce 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.[1] According to a recent study by the University of Texas Center for Research in Electronic Commerce (cism.bus. utexas.edu), the US Internet economy generated a revenue of $301 billion and was responsible for 1.2 million jobs in 1998.[2] 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 of e-commerce activities has been phenomenal and is expected to increase even further.

As a way to structure the analysis of and discussions about e-commerce systems, I propose a reference model for e-commerce. I've used this model to develop a proposal for a graduate program in e-commerce that will help students meet the challenges of e-commerce.

A REFERENCE MODEL FOR E-COMMERCE

My model comprises three submodels (see Figure 1). The top-level submodel is the *business model*, which determines what products an e-commerce site offers to its customers and how it offers them. It describes these aspects:

- *Type of business*. This includes e-tailers, auction sites, B2B, e-malls, and vertical and functional hubs for B2B interactions.
- *Type of products*. This includes physical products that must be shipped (for example, books, CDs, and computers), digital products that are delivered over the Internet (for example, reports, journal articles, audio files, and software), and services (for example, online trading of securities, insurance brokerage, and home and car financing).
- *Revenue-generating model*. This model determines how an e-commerce site obtains revenue from its activity. Revenue can come from direct sales of products, subscriptions, or advertisements.
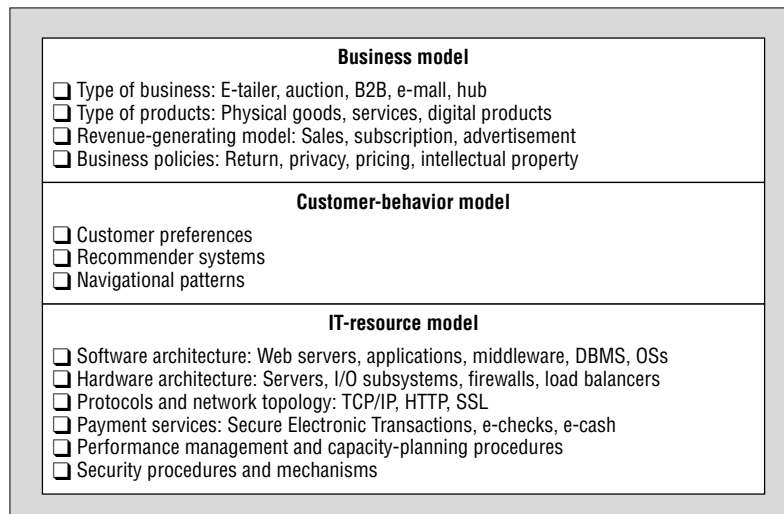
- *Business policies*: Policies of interest at this level include product return policies, privacy policies (for example, how a site treats information such as who bought what and when), pricing, and intellectual-property considerations.

At the reference model's middle level, we need to understand and model how customers use an e-commerce site and interact with it. The *customer-behavior model* deals with these issues:

- *Customer preferences*. By combining customer tracking (for example, through cookies) and data mining, e-businesses can create customer profiles to tailor content and advertising to each customer.
- *Recommender systems*. The technology is already available to match consumers with their "digital soulmate" in large databases of buying profiles. Recommender systems can suggest to customers, with a significant degree of success, what products they might be interested in, based on their digital soulmate's profile.
- *Navigational patterns*. A *session* is a sequence of consecutive requests from a customer to an e-commerce site. Graphs such as the Customer Behavior Model Graph[3] can capture a session's navigational patterns. The CBMG's nodes represent an e-commerce site's functions (for example, browse, search, add to shopping cart, or pay). The transitions between these nodes are labeled with the probabilities that a customer will move from one node to the other during the session. These graphs can help provide metrics such as the average number of visits to the graph's nodes, average session length, and buy-to-visit ratio. Other interesting relationships can also be derived. For example, research has shown that for a particular e-tailer, the buy-to-visit ratio decreases with the square of the session length.[3]

The bottom layer deals with the IT resources needed to support e-commerce. The *IT-resource model* includes these components:

Figure 1. An e-commerce reference model.

Business model
❑ Type of business: E-tailer, auction, B2B, e-mall, hub
❑ Type of products: Physical goods, services, digital products
❑ Revenue-generating model: Sales, subscription, advertisement
❑ Business policies: Return, privacy, pricing, intellectual property

Customer-behavior model
❑ Customer preferences
❑ Recommender systems
❑ Navigational patterns

IT-resource model
❑ Software architecture: Web servers, applications, middleware, DBMS, OSs
❑ Hardware architecture: Servers, I/O subsystems, firewalls, load balancers
❑ Protocols and network topology: TCP/IP, HTTP, SSL
❑ Payment services: Secure Electronic Transactions, e-checks, e-cash
❑ Performance management and capacity-planning procedures
❑ Security procedures and mechanisms

- *Software architecture*. This includes the various software servers (for example, HTTP, application, and database servers), middleware, and operating systems.
- *Hardware architecture*. This includes the boxes, I/O subsystems, crypto accelerators, firewalls, routers, and load balancers that constitute the site.
- *Protocols and network topology*. An e-business site's hardware elements are connected through various local area networks, or through wide area networks in the case of distributed e-business sites. A site's connectivity to an ISP is an important element of the site's networking topology. Another important element is the set of protocols the site uses. These include the mandatory TCP/IP and HTTP, but might also include Secure Sockets Layer (SSL) or S-HTTP to support authentication.
- *Payment services*. An e-commerce site might support various types of payment services, such as Secure Electronic Transactions (SET) for credit card payments, digital checks, and e-cash.
- *Performance management and capacity-planning procedures*. Sites that exhibit poor performance, in terms of response time or availability, tend to lose customers to other sites or to brick-and-mortar stores. So, an important element of this model is the set of the site's procedures for performance management and capacity planning.
- *Security procedures and mechanisms*. Security is fundamental to an e-business site's operation. Various aspects of security must be managed: mutual authentication of the parties involved in transactions, protection of the confidentiality of customers' information (for example, credit card numbers), protection of a site's resources (for example, servers and backend mainframes) from unauthorized use, and protection against denial-of-service attacks.

CHALLENGES IN E-COMMERCE

E-commerce has been a big success already, but challenges lie ahead. Let's look at some of these challenges in light of the reference model.

THE BUSINESS MODEL

The challenges at this level involve legal, taxation, pricing, and privacy issues. Legal issues include the determination of an e-commerce transaction's jurisdiction. Suppose a customer in Hong Kong buys a computer from an e-tailer headquartered in San Francisco, and the computer the customer receives does not work as advertised. The customer complains, but the merchant does not believe any action is necessary. A dispute arises that must be settled in court. Which court? In San Francisco? In Hong Kong? The first option favors the merchant, while the second favors the customer.

Another legal issue involves contract negotiation. This is particularly important in dynamic B2B marketplaces, where special software agents negotiate contracts through the Internet by using machine-readable languages to specify a contract's business rules.[4] These contracts must be digitally signed, and the parties must be mutually authenticated. Although a digital signature is much harder to forge than a physical signature on a paper contract, most courts do not accept digital signatures. Eventually, legislation will catch up with technology.

An important public-policy issue is the regulation of taxation of products and services sold through e-commerce. Not much has been accomplished regarding these matters.

Pricing strategies are important in dynamic markets such as those characterized by auctions. An e-business site might launch robots to probe the price of its most important competitors before displaying a price requested by a customer.[5] This process should be fast enough to avoid a response time that is too long for the customer. So, a site might not wait for all the answers before making a decision. (For a discussion on pricing strategies, see the papers by Christopher Brooks and his colleagues[6] and Andrew Odlyzko.[7]) Pricing is also important when an e-business site sells bundles of items as opposed to single items.[8]

An important privacy issue is that few sites post privacy statements. These statements tend to be long and complex and are seldom read or understood by users. A recent development, the World Wide Web Consortium's (W3C) Platform for Privacy Preferences Project (www.w3c.org/P3P) could solve this problem.[9] 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 user's privacy preferences. Good tools are needed at the browser level for setting and managing privacy preferences and for alerting users of privacy policy mismatches.[10]

THE CUSTOMER-BEHAVIOR MODEL

At this level, better and more efficient techniques are needed to enhance the customer's shopping experience. This includes dynamic customization based on past history and the 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 accesses an e-commerce site from a low-bandwidth personal digital assistant (PDA), the site should send summarized text-only descriptions of catalog items.

Figure 2. A proposed e-commerce curriculum.

	Core courses	Electives (select two at each level)
Business model	❑ The Information Economy ❑ E-commerce Business Models ❑ Marketing ❑ Privacy and Law for E-commerce ❑ Pricing on the Internet ❑ Supply Chain Management	❑ Financing ❑ Distribution Channels ❑ Order Fulfillment ❑ Taxation ❑ Accounting
Customer-behavior model	❑ Recommender Systems ❑ Workload Characterization ❑ Data Mining ❑ Statistical Data Analysis	❑ Human Factors ❑ Marketing Research ❑ E-advertisement ❑ Dynamic Customization
IT-resource model	❑ Networking ❑ Security ❑ E-commerce Sites Software Architectures ❑ E-commerce Sites Hardware Architectures ❑ Performance Evaluation ❑ Payment Systems ❑ Human–Computer Interaction	❑ Advanced Networking ❑ Software Agents ❑ Databases ❑ Client-Server Systems and Middleware ❑ Multimedia ❑ Advanced Security

If the customer has a high-bandwidth connection, the site could send colored pictures and more extensive descriptions. Another interesting development is software agents for e-commerce.[11] On the basis of a customer's profile, an agent can alert the customer about an item's availability at a specified price. Recommender agents can suggest what to buy.[12]

THE IT RESOURCE MODEL

Typically, after waiting eight seconds for a page to download, users become impatient and take their business elsewhere. This is known in the industry as the "eight-second rule." When a user clicks out of a site, sales might be lost. Experimental evidence has shown that a mere increase of one second above the eight-second threshold might increase the click-out rate from 8% to 30%.[13] Bad performance might scare prospective buyers during a single visit or might lead them to avoid a site altogether. However, any estimated potential annual losses in sales must be weighed against expenditures in software, hardware, and bandwidth for improving performance.

Performance problems tend to worsen as the number of wireless PDAs increases and as new interfaces, such as voice user interfaces (see www.generalmagic.com), to e-commerce sites become more prevalent. These interfaces will let people access e-commerce sites in many different new situations. For example, imagine someone driving a car and being alerted through a voice interface that certain stocks in his or her portfolio are down 10%. The driver 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.[14,15]

DESIGNING AN E-COMMERCE CURRICULUM

An analysis of e-commerce graduate degrees shows that some are well balanced between technology and business but that others are skewed toward one or the other. I propose a curriculum that cuts across the reference model's three levels, providing a balance across the levels but not necessarily between technology and business.

Figure 2 outlines this curriculum. From each level, the student must take a set of core courses and two electives, for a total of 23 half-semester courses. Some courses in our proposal already exist in CS departments (for example, Networking, Security, Databases, and Performance Evaluation) and in business schools (for example, Marketing, Financing, and Supply Chain Management), while some others would have to be created (for example, Recommender Systems, Pricing on the Internet, and E-advertisement). (See the sidebar, "Existing courses in e-commerce," for examples of programs and courses.) In some cases, parts of other courses might already cover some of these topics. Repackaging would be needed.

A description of each course in Figure 2 is outside this article's scope. The titles should convey the idea of what each course should cover. Not all courses should be oriented toward e-commerce. For example, the Marketing course should cover basic marketing fundamentals and then show how the Internet has added a new dimension to marketing.

A program such as this one requires a certain level of maturity and experience from entering students. To be admitted, candidates should have graduated from college with a degree in business or computer science and should have a minimum of three years of relevant work experience.

As e-commerce grows, the need will increase for people who have the skills to understand all its aspects and to rise to its challenges. Although my e-commerce curriculum is (intentionally) not complete or detailed, I hope it will be a useful guide to institutions that want to design their own e-commerce graduate programs to provide those skills.

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Existing courses in e-commerce

Many universities offer e-commerce programs. These programs vary from specializations or concentrations in traditional programs (for example, an MBA with a concentration in e-commerce) to graduate degrees in e-commerce. In some cases, a single school (for example, the school of business) hosts the program; in other cases, more than one school or unit (for example, the school of business and the computer science department) offers it. Figure A lists some institutions offering graduate programs in e-commerce. We'll now look at the approaches taken at three of these institutions.

- Bentley College, Graduate School of Business
- Carnegie Mellon University
- Columbia University
- Copenhagen Business School
- Duke University, Fuqua School of Business
- Emory University
- Georgia State University
- Hong Kong University
- Pennsylvania State University
- Rutgers University, Newark
- University of California at Berkeley, Computer Science Division and Haas School of Business
- 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, Kenan-Flagler Business School
- University of Pennsylvania, Wharton School
- University of Texas, Austin
- Vanderbilt University, Owen Graduate School

Figure A. Some institutions that offer graduate programs in e-commerce.

The MBA program at the University of Maryland's Robert H. Smith School offers a cross-functional concentration on e-commerce 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). 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 an MS in electronic commerce. Students must take 23 one-quarter courses (www.ecom.cmu.edu/program/courses). Nine of the 18 required courses come from the Graduate School of Industrial Administration (business courses): 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. The other nine are e-commerce courses from the School of Computer Science (technology courses): 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. This leaves five electives. Some business electives are Marketing Research, Price, Order Fulfillment, and Managing Customer Service Businesses. Some technology electives are Databases, Data Mining, Electronic Negotiation, Intelligent Agents, Web Architecture, and Java Programming.

Georgia State University has created the eCommerce Institute as part of the J. Mack Robinson College of Business (cis.gsu.edu/digicomm). The institute offers an executive e-MBA and a regular e-MBA. The program is organized around two international seminars and five "minimesters" (two per academic-year semester). Courses include e-Marketing, e-Infrastructure, e-Accounting, e-Conomics, e-Decisioning, e-Finance, e-Supply Chain, e-Technology Applications, e-Change, e-Strategy, e-Security and Payment Systems, e-Policy, and e-Law.

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