The Changing Face of E-Commerce:
Extending the Boundaries of the Possible

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E-commerce is growing at an exponential rate—literally. According to one study, the Internet economy grew at a rate of 174.5 percent annually from 1995 to 1998.[1] This growth follows the equation

$$\text{Internet economy} \propto e^{\text{year}}$$

almost exactly (remember, the natural log, e, = 2.718...).

A number of analysts forecast that the Internet economy will exceed US $1 trillion ($10^{12}$) in 2002; Forrester Research (http://www.forrester.com) recently predicted that the worldwide Internet economy will reach US $6.9 trillion in 2004.

Media hype seems to follow a similar exponential curve.

Real Economic Change

Nonetheless, strong forces are driving real economic change. Minuscule transaction costs, obliteration of distance, and easy sharing of information all enable new ways of doing business. The explosive speed lets us be sloppy about details—if you don't like a forecast, change the date by a few months; if you want to use a different currency (Canadian dollars, Australian dollars, Euros), just shift the time base a little.

An interesting fine structure underlies this smooth curve. Much of consumer buying is seasonal—think of back-to-school textbooks, Christmas toys, St. Valentine's Day flowers. Every so often a special event occurs (such as the Super Bowl with its dot-com ads) that leads to a sudden jump in e-commerce activity. Business-to-business (B2B) commerce has grown in a different way: When a large organization decides to use the Internet for procurement and marketing (supply chain and customer relations), billions of dollars are quickly added to the Internet economy.

To provide satisfactory service despite these cycles, ramps, and spikes, we need new system, application, and network management approaches.

Evolution of E-Business

Investors and the media have focused on several areas in quick succession, each with its own computing requirements.

At first, people saw e-commerce as synonymous with online consumer shopping (business-to-consumer, or B2C). Success in that area required search capabilities, graphic portrayal of products, payment processing functions, personalization, and fulfillment, as well as concern for privacy and security. New user interfaces have been honed in the B2C space, as have online functions like auctions.

Public interest then shifted to consumer portals, which aim to create "stickiness" and encourage return visits through engaging content (including audio, video, and 3D images), social interactions like chat, easy navigation tools, and preferential access to selected business participants.

As it became clear that an order of magnitude of more money would move in B2B channels than in B2C, attention moved to interbusiness commerce. B2B transactions are dominated by high business value, long-term relationships, complex business processes, intercomputer communications (first EDI, then XML-based messaging), security, and a multitude of transaction models.

In a remarkably short time, B2B portals morphed into exchanges and more recently into complex marketplaces that combine aspects of negotiation, information, business processes, and social interaction. Marketplaces will provide basic support for auction, search, payment, insurance, and security, enabling participants to construct highly profitable but more complicated deals.

In general, interest has expanded from the limited functions of e-commerce (consummating purchase transactions on the Web) to much more general e-business (executing the many processes within and between organizations through networked computing systems). The next phases are likely to include mobile or pervasive e-business (m-commerce) and interorganizational business (virtual enterprises).

Challenges and Changes

This litany of evolutionary phases masks a number of growing technical challenges, including

- security and authentication;
- content management and publication;
- reliable systems, messaging, and data;
- complex interactions and transactions;
- business model implementation and business process enactment; and
- distributed processing and distributed data.

High-end sites may handle hundreds of thousands of hits per minute, present and update catalogs with many millions of items, collect tens of gigabytes of behavioral data per day, run hundreds of separate processes or businesses simultaneously, and utilize thousands of processors to carry the load.

Technical changes are enabling new ways of doing business. As the cost and delay of messaging become negligible, negotiation and competitive bidding can be the norm rather than the exception. Web technologies like authentication, standard messaging, and rapid data sharing already support spontaneous, secure, and multiparty interactions among businesses. Groups of consumers can band together as easily as guilds of sellers, with the help of discovery technologies and online databases. Innovative forms of payment and finance are being introduced to meet new needs. New intermediary services will add value by accumulating and analyzing information and using it to simplify technical and business problems. Intelligent agents will finally earn their keep by providing such services.

Of course, good business techniques are still important, and their effects are amplified by Web technologies. The marketplace is now truly global and simultaneous, with buyers, sellers, intermediaries, and

agents that can react at any time from any place. Yet businesses still need to be sensitive to local requirements because of cultural sensitivities, regulatory differences, and infrastructure capabilities. Strategic thinking is even more important when goals involve more players and more rounds of interaction, as is common when the supply web becomes more complicated, and many alternative business deals are possible.

There has been a rebirth of interest in game theory. New approaches to marketing, such as targeting individual

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customers at specific moments based on very recent behavior or when they are physically near a store, become profitable when new types of information (such as customer clickstreams) are available, but first patterns must be extracted from terabytes of data (some high-end companies already apply rudimentary forms of this analysis).

Re-envisioning Software Development

The accelerating tempo of business and the pressure to get to market quickly are also revolutionizing the way commercial software is built and managed. Some companies revise their entire business model every six months—faster than they can redesign their software by traditional means. Such firms must balance compressed software development with customer satisfaction. On the other hand, when significant sums are at risk, parts of the application must be thoroughly

trustworthy. Meeting the contradictory requirements of continuously available, highly flexible, rapidly changeable software that is at the same time perfectly reliable and stable calls for innovative techniques and tools. Instead, most implementations today depend on energy, skill, and luck.

Rather than buying and running a piece of software, a firm can now access an application through an application service provider (ASP) or business process outsourcer (BPO) over the Net, and use it as a short-term transaction or as part of a long-term relationship.

Although dynamic access to services (including discovery, ad hoc workflows, and late binding) is a staple of research in distributed computing and networking, only now are business cases starting to close and enormous bets being placed. Once specific services are easily outsourced, more complicated multi-company projects and virtual enterprises will be feasible.

The technical demands will be enormous—and exciting. Researchers are extending the boundaries of the possible in many areas of computing. In coming issues, this column will examine these stresses and their likely or hoped-for solutions. ∎

REFERENCE

1. The Internet Economy Indicators, Indicators Report, June 1999, available online at http://www.internetindicators.com/features.html.

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