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Christoph Schlueter Langdon
University of Southern California, christoph.langdon@marshall.usc.edu

Michael J. Shaw
University of Illinois at Urbana-Champaign, m-shaw2@uiuc.edu

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Christoph Schlueter Langdon
Information Systems and Operations Management Department
Marshall School of Business
University of Southern California
Bridge Hall 401
Los Angeles, CA 90089-1421
<christoph.langdon@marshall.usc.edu>

Michael J. Shaw
Department of Business Administration
Beckman Institute for Advanced Science and Technology
National Center for Supercomputing Applications
University of Illinois at Urbana-Champaign
350 Commerce West Building
1206 South Sixth Street
Champaign, IL 61820
<m-shaw2@uiuc.edu>

Abstract-This paper aims to categorize some of the fundamental information systems (IS) challenges with the development of consumer-oriented electronic commerce or online retailing. With the emergence of new online intermediaries such as America Online, Amazon and eBay, many traditional firms are at risk and need to respond. Despite their size and retailing experience most of the incumbent retailers such as Wal-Mart in the U.S. or Metro in Europe have been slow to develop successful online channels. IS-based forward integration into customer activities, such as product and price search, and the development of electronic backends ("e-backends") have been identified as the two major and distinct inhibitors to online retailing success. Our analysis and findings draw from information system design work with retailers in the U.S. and Europe from 1997 through 1999.

I. INTRODUCTION

In 1996, Swiss-based Metro Group, the world's second largest retailer in 1998, recognized the emergence of a new retail channel, something called electronic commerce. To expand or at least protect its traditional retail business, Metro purchased a small Internet service provider and targeted the German market with an aggressively-priced Internet service, saying, "In the bricks-and-mortar world, we build our customers a parking lot so that they can reach us. Internet access is like a parking lot." Metro, like many traditional retailers entering electronic commerce, looked first to invest in online elements with which they could somehow associate with the world of parking lots, shelf space and cash registers. A few of the earliest interactive grocery stores even had customers wander down virtual isles and pull virtual boxes of corn flakes from virtual shelves. It is an interesting observation that in the beginning of Internet commerce, as it still is today, the online retail success stories, such as Amazon, eBay or CDNow, are not from the world of retailing. Success in consumer electronic commerce appears to be less determined by things like parking lots and shelf space. Furthermore, profitability, as we will illustrate, will not simply be a function of substituting store rent with rented server space and Internet access. Instead our observations suggest that success may depend on IS design, integration and management skills. Our insights have been developed while working with large retailers and manufacturers in the U.S. and Europe on electronic commerce business development and IS architecture design.

II. ELECTRONIC MARKETS AND ELECTRONIC COMMERCE

From an economic perspective, the development of electronic commerce is first and foremost driven through transaction cost savings. Researchers have demonstrated that the application of information and communication technology can lower transaction cost between two business processes or firms, making coordination through markets more favorable than hierarchy or vertical integration [1]. In order to allow for this shift, intermediaries are required to develop, build and operate electronic market systems and supporting infrastructure [2, 3]. Since the early 1990s, new intermediaries have emerged to create electronic markets and "virtual value chains" [4, 5]. In information industries, these intermediaries have already started to transform traditional industry structures [6, 7]. In response to the introduction of Web browsing technology in the mid 1990s, Internet infrastructure has reached a level of accessibility and sophistication that allows for electronic markets in many physical consumer good categories. According to market researchers, the size of consumer electronic commerce is estimated to be between $4 billion and $10 billion in the year 2000 worldwide (IDC, Yankee Group, Forrester Research, Cowles/SIMBA, Jupiter; [8]).

III. THE ONLINE FORWARD INTEGRATION CHALLENGE

Amazon and Dell Computers are currently setting the benchmarks other online retailing pioneers are trying to achieve in consumer electronic commerce.

Amazon's position in the new online channel for books looks a lot like a traditional retailer's, however, with an important distinction. While retailers have usually left activities such as product and price search, home delivery and bundling to the consumer, Amazon and others have integrated forward into these activities, extending the value chain, doing, in essence, more of the consumer's work. Online customers no longer have to search for products, product attributes and price by travelling from store to store. Instead, consumers can increase market transparency by entering key words or clicking buttons on a site like Excite's Jango comparison shopping agent. Instead of picking up goods at a store, online retailers like Webvan have goods delivered to the customer's doorstep. Some online stores even try to anticipate customer's wants and needs and invest in systems that promise to allow for one-to-one selling [9].

While one retailing trend of the past decades has been to achieve efficiency by handing more value adding activities to the consumer, such as logistics (i.e., by moving outlets away from city centers to locations near major highways), or, final product assembly (i.e., as the Swedish furniture maker and retailer IKEA has done), most online retailers decided to do just the opposite. Figure 1 reveals the structural distinction between traditional and online value chains.
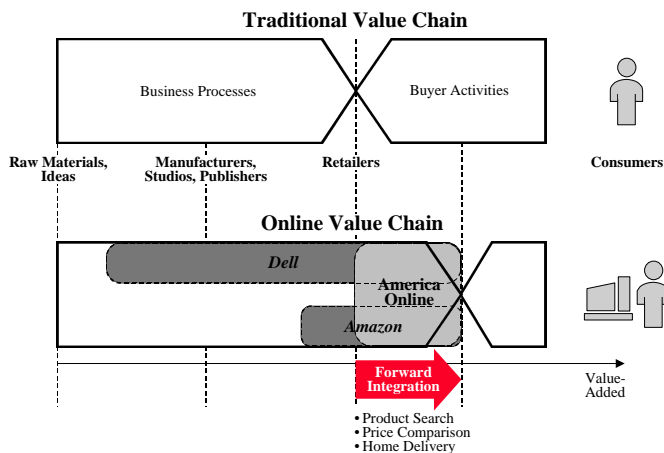

Fig. 1. Online Forward Integration in Consumer Electronic Commerce.

Forward integration has so far paid off handsomely for Amazon in terms of sales and market capitalization. Its success attracting buyers is changing retailing and has forced incumbents like Barnes and Noble and Bertelsmann to quickly follow into electronic commerce (Barnes and Noble started www.barnesandnoble.com, Bertelsmann created www.bol.com and has since acquired a stake in barnesandnoble.com). Similarly, Dell has been enjoying strong sales grow for the past years replacing Compaq as the No. 1 seller of personal computers in 1999 in the U.S.

It is important here, however, to note an important difference between the online sellers Amazon and Dell. Despite impressive sales growth, Amazon has not yet shown a profit and, as analysts point out, the financial model isn't proven yet [10]. Dell is comfortably in the black. A closer look at the Amazon and Dell value chains reveals that while Amazon has limited its business to

selling, Dell controls much of the entire PC manufacturing, assembly and distribution chain as illustrated in Figure 1. Dell has eliminated traditional intermediaries such as wholesalers and retailers. Furthermore, Dell has also harnessed the Internet to streamline operations and to extend its control upstream in the supply chain without ownership of all the assets and skills required. Dell's combination of direct selling and backward integration has moved the point where pull turns to push further upstream in the supply chain increasing Dell's flexibility in the marketplace and saving inventory carrying cost. Michael Dell, founder and CEO of Dell Computer Corporation, refers to his concept as "virtual integration" [11].

Although forward integration allows online sellers to develop a service edge over traditional retailers, instant return may be questionable for two reasons:

First, forward integration does not come cheaply. In order to improve its product and price search capability, Amazon, for example, in 1998 paid $150 million for Junglee, a maker of online search technology. Prior to its purchase by Amazon, Junglee had "powered" Yahoo!'s Shopfind section. Furthermore, the already high cost of forward integration appears to be rising rapidly. While America Online paid $35 million to acquire the Internet software developer BookLink Technologies and its InternetWorks Web browser in order to add Web browsing capabilities to its user interface in November 1994, four years later it had to pay $4.3 billion for Netscape, the maker of the Navigator Web browser. Although the acquisition includes also Netscape's Netcenter Web portal, as well as electronic commerce server software, the price for Web browsing technology and its development team appears to be orders of magnitude higher than just a few years ago.

Second, despite the steep cost of online forward integration consumers tend to expect these additional services for less. Direct sellers such as Dell and the initial free-for-all culture on the Internet appear to have fostered the perception that goods bought online ought to be cheaper than at the store down the street. Dell, which doesn't need wholesalers and benefits from its "virtual" or streamlined supply chain, is saving cost, some of which can be passed down to consumers. On the other hand, online sellers that function like Amazon, who still rely to a great extend on traditional channel partners, such as distributors, cannot.

Doing more for less sounds like a contradiction and appears to be one likely reason for a lack of profitability in consumer electronic commerce.

IV. THE "E-BACKEND" CHALLENGE

While front-end development has received plenty of attention very little thought has been given to the online retailing backend, which we refer to as "e-backend". Designing appealing online storefronts is only one part of developing an online store. Based on our work with retailers in the U.S. and Europe we estimate that the storefront—Web site structure and navigation, artwork, and online product catalog—may only account for 20%-30% of the total development cost. Most of the initial investment relates to the development of backend information systems to support online retailing processes. Figure 2 provides a high-level overview of the four major categories of online retailing processes.
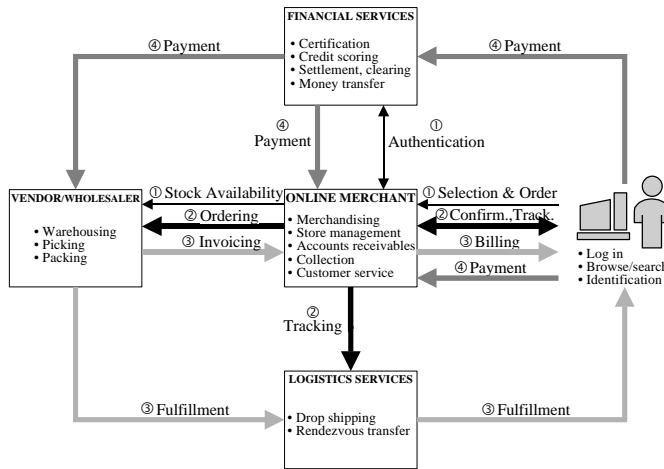
Fig. 2. Major Processes and Interfaces in Online Retailing.

In order to take advantage of the Internet's reach online retailing processes have to be automated: First, many activities require real-time execution. Examples are stock availability checking, address plausibility evaluation, user authentication and credit risk scoring. Second, most activities have to be performed around the clock which makes manual operations prohibitively expensive given the slim margins in consumer goods retailing.

The retailers we have worked with were caught by surprise by the amount of IS work in business process automation (see Figure 2). Furthermore, problems mounted when they had to find out that end-to-end IS solutions for online retailing were not available—an observation confirmed by product comparisons in trade journals [12, 13, 14, 15, 16]. The applications that came close, such as Broadvision's One-To-One Server and OpenMarket's Transact/LiveCommerce, were not "out-of-the-box" solutions. Instead, the rich functionality and flexibility of these applications came at the expense of high design complexity and extensive programming efforts.

Two additional problems complicated the e-backend challenge. First, the back-end information systems had to be integrated with the store front-end applications and with existing legacy systems of channels partners, such as distributors and parent companies. While standards for online communications (i.e., TCP/IP) and online information services (i.e., HTTP, HTML, and URL) have been widely adopted [17], there continues to be a lack of electronic commerce standards. Standardization efforts like SET (Secure Electronic Transaction) for online credit card transactions and CORBA (Common Object-Oriented Request Broker Architecture) have only recently received more widespread recognition [18, 19]. In order to link electronically with distributors and manufacturers we observed that online retailers had to design and write customized interfaces each time. Furthermore, the proliferation of online shop and portal features, such as Web-based e-mail (i.e., Microsoft's purchase of Hotmail for its Microsoft Network Internet portal in 1998) and shopping agents (i.e., Amazon's acquisition of Junglee in 1998), turned architecture development and systems integration into a moving target.

The second major problem with e-backend development that we observed relates to IS skills. Usually, retailers have not developed competencies in IS design, integration and testing the way, for example, many large financial service institutions have.

The firms we worked with had to rely on information systems vendors and consultants to design, develop and implement their online shopping platform.

Also, we observed that demand for IS skills continued to be high even as companies moved from the development stage to operations. 24 hours and seven days a week operations require high levels of IS support and maintenance. In particular if the scope of business activities is wide and IS-based automation, therefore, extensive. Extensive business process automation using customized IS in turn, made it difficult to outsource activities. In High Street retailing, the retailer does not operate credit card payment systems and networks, but credit card companies like Mastercard, Visa and American Express do. And even these credit card companies to not install and maintain the front-end systems—the in-store credit card readers—but third parties, such as Verifone, do. The firms we worked with had little opportunity to outsource these peripheral but vital operational tasks.

V. IMPLICATIONS

Online sellers have used IP-based applications to integrate forward into activities traditionally performed by consumers, such as product search, price comparison and home delivery logistics. In order to take advantage of the Internet's reach and so that online retail services can be offered economically, the activities previously performed by the consumer, as well as traditional retailing processes require automation. Furthermore, as demonstrated by PC manufacturer Dell, upstream supply chain structures may have to be altered to more quickly and efficiently respond to consumer demands.

Currently, there are many hurdles to achieving online retail automation and forward integration economically.

In the business development phase online retailers may want to carefully consider their scope of activities. Less vertical integration directly reduces initial IS development efforts as well as operations and maintenance cost later. While Amazon added to the set of traditional retailing activities, eBay, an online auction site, has limited the scope of its online business to providing an electronic marketplace for consumer-to-consumer trading. As such, eBay has, in a sense, outsourced purchasing, in- and outbound logistics and even payment settlement to its customers and, as a result, has been operating in the black within a year after start up in September 1995.

In the e-backend construction phase, a lack of end-to-end software applications and standards is hindering economical feasibility. Online retailing systems still require significant customization and application interface development work.

In the platform operation phase, there remains a lack of transactional support services. The latter, in particular, diverts scarce IS resources into non-core online selling areas such as payments and information systems maintenance. This, therefore, leaves few resources to develop new skills such as automated customer service or user profiling.

In summary, our observations suggest that IS-based forward integration and e-backend development problems can cause delays that can exceed one year.

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