Chapter 7. ICT and the Paperboard and Packaging Industry

Peter Ince, Sanna Kallioranta, and Richard Vlosky

7.1 Introduction

The purpose of this chapter is to describe the reasons for the development of ICT and e-business systems in the paper and paperboard packaging industry and to discuss future scenarios that may serve to guide forest-sector research in this topical area. The paper and paperboard packaging industry encompasses producers of primary paper and paperboard packaging materials (paper and paperboard mills) plus secondary producers who convert paper or paperboard into packaging products, such as corrugated containers, boxes, sacks, or other forms of paper or paperboard packaging. Some firms in the industry are vertically integrated, being both primary paper or paperboard producers and secondary converters.

Beyond general reasons for the development of ICT and e-business systems, the chapter focuses on ICT and e-business developments that are unique to the packaging industry, for instance, the ongoing development of "active" or "intelligent" packaging systems. Several hypotheses are explored regarding the market consequences of ICT developments for primary paper or paperboard producers, leading to a set of speculative future scenarios. Forest sector research needs are identified in relation to those market scenarios, including the need for 1) economic models to evaluate market impacts of ICT and e-business developments and 2) research on how to identify and take full advantage of ICT and e-business applications in the context of competitive corporate strategies.

7.2 Background

An overview of ICT and e-business developments in the paper and paperboard packaging industry reveals that some ICT developments are fairly unique to the sector, whereas other ICT developments are shared generally with other business sectors but have unique impacts within the sector. One unique ongoing ICT development is that of active and intelligent packaging ("interactive" packaging). Along with increased use of paper and paperboard packaging in display advertising, interactive packaging offers expanded future markets and applications for paper and paperboard packaging. Other ICT developments shared generally with other business sectors include virtual supply chain integration and collaboration, online product sales and ordering, and business-to-business market exchanges, which have general and also unique benefits and consequences within the paper and paperboard packaging sector. Most of these developments appear to share a common set of motives or drivers, including the goals of greater cost competitiveness, operational efficiency, and exploitation of new market opportunities, linked to business strategies.

7.2.1 General strategic drivers of ICT and e-business development

The goal of competitive advantage is one of the general strategic drivers of ICT and e-business development within the paper and paperboard sector. An industry survey by Vlosky (2000) revealed that gaining competitive advantage, making the company more responsive to customers, and attracting and retaining customers were the most important reasons for implementing Internet business technologies (e-business) in the United States (U.S.) paper industry. Moore (2002) also noted that among United Kingdom paper businesses, the motivators for e-business were competitive pressure and changing customer needs.

Armstrong and Sambamurthy (1999) argued that the effective application of ICT supports, shapes, and enables the firm's business strategy and value chain activities. According to Varadarajan and Yadav (2002), e-business technologies can potentially influence the competitive market strategy of a business and the efficiency of its operations. Chan and Davis (2000) stressed that the decision to implement e-business solutions should be derived from business or market strategies.

The prevailing business strategy for many primary paper or paperboard manufacturers has been to become a low-cost producer of fairly standard commodity products, such as standard grades of paper or paperboard, focusing primarily on tonnage produced and cost-efficiency (Klass, 1999). This particular business strategy (the cost-leader strategy) leads to corresponding expectations for ICT and e-business. The expectations of the cost-leader strategy can be compared and contrasted with expectations of other business strategies according to Porter's (1985) generic strategy types (*Table 7.1*).

Table 7.1. Expected contributions of ICT development among Porter's (1985) generic business-strategy types.

Strategy type	Expected utilization and contribution of ICT
Cost-leader	Efficient operations Reduced transaction costs Standardized and efficient customer service
Differentiation	- Value-added services Differentiated exchange experience Tailored solutions Mass customization
Focus	- Improved relationships Entry barriers
Broad-scope	- Cost-effective to offer customization to a broad scope of partners
"Stuck-in-the-middle"	- Repeat offline business processes Imitate competitors

The cost-leader strategy has also been a driving force behind consolidation and cost-reduction trends in the paper and paperboard industry, and e-business implementation is seen as another opportunity to enhance cost leadership by decreasing transaction costs, increasing process standardization, and improving efficiency. These potential cost savings are very important, both for the paper and paperboard industry in general and for the emergence of e-business within the industry. Stundza (1999) argued that many industry executives in commodity sectors such as the paper and paperboard sector are hesitant to commit large capital expenditures for ICT or e-business until they see enhanced profits ("bottom-line results") by lead adopters.

Pursuant to the cost-leader strategy, the primary paper and paperboard industry has also focused on maximizing product output or capacity utilization (sometimes called the "production-push" strategy); but a recognized challenge for paper or paperboard companies that wish to be successful is to broaden their focus from production volume and efficiency to market needs and customers. Interestingly, ICT and e-business can support company efforts to move from production orientation toward market orientation, giving ICT the potential to offer intangible market-oriented benefits for the paper, paperboard, and packaging industries.

For example, e-business via an extranet[1] (external network) can serve to deepen business partnerships and collaboration (Anandarajan *et al.*, 1998). Companies can also engage supply chain

[1] Extranet—The extension of a company's intranet out on to the Internet (e.g., to allow selected customers, suppliers, and mobile workers to access the company's private data and applications via the World Wide Web). This is in contrast, and usually in addition, to the company's public Web site that is accessible to everyone. The difference can be somewhat blurred, but generally an extranet implies real-time access through a firewall of some kind. Such facilities require very careful attention to security but are becoming an increasingly important means of delivering services and communicating efficiently with customers. Source: hyperdictionary (http://www.hyperdictionary.com/dictionary/Extranet).

partners more broadly in joint product development and intelligence sharing (McCune, 1998). Furthermore, ICT and e-business investment allow businesses to pursue a market differentiation strategy by securing unique relationships, such as through improved service quality and their ability to respond quickly to market shifts (Baharadwaj *et al.*, 1993). In addition, Anandarajan *et al.* (1998) argue that having an extranet may lead directly or indirectly to enhancing corporate image. Vlosky (2000) also found support for that argument in the paper industry.

Overall, ICT and e-business success will derive from the ability of individual companies and their business partners to take full advantage of Internet marketing opportunities addressing market segmentation, promotion, distribution, pricing, information management, and customer satisfaction (Vlosky, 2000). For the paper and paperboard packaging industry, this implies that future development of ICT and e-business will expand the expected contributions of ICT and e-business beyond the narrow expectations of the cost-leader strategy and perhaps shift expectations toward other contributions, such as more efficient and value-added exchange-support services.

Table 7.2. Dominant problems in supply chain or value chain management, and potential benefits of e-business.

Value chain activity	Problem	Potential benefits of e-business
Inbound logistics and procurement	- Long lead time - Incompatible IT systems - Supplier selection	- Increased collaboration - Reduced order cycle - Reduced search cost - JIT (just-in-time) inventory - Responsive supply - Small and frequent purchases
Production and operations	- Inaccurate demand forecast - "Bullwhip" effect - Excess inventory	- Sharing supply and demand information - Use of timely and accurate data in planning - Better demand forecasting - Reduced "bullwhip" effect - Reduced inventory
Outbound logistics and distribution	- Multiple intermediaries - Delivery costs	- Elimination of intermediaries - Electronic delivery - Accurate shipment - Availability of tracking information
Marketing and sales	- Costly and difficult market information attainment	- Improved market and customer information - Faster documentation process - Faster payment cycle - Lower communication costs - Improved relationship
Service (during and after)	- Response time - Costly customized information	- 24/7 information access - Faster response - Customized service at lower cost

From: Porter, 1985; Anandarajan *et al*., 1998; Chan and Davis, 2000; Tan *et al*., 2000; Vlosky *et al.*, 2000; Ling and Yen, 2001; Lin *et al.*, 2002; Moore, 2002.

Of course, the potential contribution of operational efficiencies achieved through ICT and e-business development [for example, reduced transaction costs via e-marketplaces, extranet, and

electronic data interchange (EDI)[2]] will remain strong drivers for ICT and e-business within the paper and paperboard sector. A broad array of potential operational efficiencies through e-business adoption can be anticipated in terms of Porter's (1985) value chain (*Table 7.2*). Paper and paperboard packaging producers confront an array of problems in managing the material supply or value chain, but in that context they can take advantage of numerous benefits conveyed by e-business to streamline their supply chain (*Table 7.2*). Paper and paperboard packaging firms can integrate their supply chain systems with those of trading partners to achieve a more efficient product and information flow.

Beyond general drivers of operational efficiency and competitive advantage, ICT also holds a promise of expanding product applications for paper and paperboard packaging. Real prices for paper and paperboard bulk commodities have generally been declining in recent decades, partly as a result of productivity gains, efficiency gains, and cost cutting throughout the industry. In this context, the industry recognizes the need to develop new value-added products and expand packaging markets to improve industry revenues and profits. That objective is connected to a set of unique motives for the development and application of ICT in the paper and paperboard packaging industry, as discussed in the next section.

7.2.2 Unique motives for ICT and e-business in paper and paperboard packaging

In addition to general drivers of ICT and e-business development, some motives for ICT development are fairly unique to the paper and paperboard packaging industry. The twenty-first century arrived with significant changes already taking place in the way that paper and paperboard were being purchased, consumed, and utilized. Drivers for change in the packaging industry include ongoing changes in retailing, changes in channels of distribution, changes in packaging expectations (with an expanded information-transfer role), and increased time pressure for moving products into the marketplace (Klass, 1999).

A shift in recent decades toward larger retail stores and mass distribution of products has helped to expand the function of packaging from traditional product containment and protection functions to sales and marketing functions. With larger retail stores and mass merchandizing, reliance on knowledgeable salespeople to assist customers with product information has declined. Instead, reliance on product packaging to advertise and inform customers about product contents and uses has increased. This trend was facilitated by technological shifts in paper and paperboard packaging materials, such as development of better printable packaging materials suitable for color printing or graphic displays, which helped packaging to assume expanded sales and marketing functions.

The impact of these trends in recent decades has been to expand markets for printable paper and paperboard packaging materials, and competition has led to a demand for higher-quality color graphics in packaging and the creation of new requirements for high-quality packaging materials (Klass, 1999). However, that development was just one phase of a broader information-technology revolution unique to packaging. Other developments, such as bar coding and the subsequent development of active and intelligent packaging in the 1990s, have expanded the outlook for packaging functions in the future. Active packaging is packaging specifically designed to change or control the condition of the packaged product, chiefly to extend shelf life, improve safety, or enhance sensory properties. Intelligent packaging is packaging designed to use electronic sensors or chemical indicators 1) to sense or transmit information about the environment, shipping conditions, or other product information and 2) to convey information to managers or to the product user. In the long run, these developments are paving the way for the emergence of packaging as a new medium of product-information transfer and enhancement of product use.

---

[2] EDI—the exchange of standardized document forms between computer systems for business use. EDI is part of electronic commerce and is most often used between different companies ("trading partners"). It uses some variation of the ANSI X12 standard (USA) or EDIFACT (UN-sponsored global standard). Source: hyperdictionary (http://www.hyperdictionary.com/ dictionary/Electronic+Data+Interchange).

Development of active and intelligent (interactive) packaging is an emerging market development closely linked to ICT and e-business; it is fairly unique to the packaging sector and therefore perhaps the best example of how ICT and e-business may uniquely impact the paper and paperboard packaging industry. Paper or paperboard packaging that includes inexpensive electronic transmitters to keep track of product shelf life, inventory data, or other detailed product specifications, or that helps customers understand how to use the product efficiently, offers broad potential for product innovation and expanded market development within the paper and paperboard packaging sector.

"Packaging is easily overlooked as fulfillment/distribution operations are planned and constructed and, yet, packaging materials and methods can have significant positive or negative impact on productivity, transportation costs, and damage/loss claims."[3] This statement is likely to be all the more prophetic with the emergence of interactive packaging systems. In the global economy, many emerging companies have little expertise in "back-end fulfillment" (procurement, distribution, global inventory management, and logistics); thus, interactive packaging provides the packaging industry with an opportunity to become the provider of new packaging system solutions, while helping customers to develop more effective packaging strategies. Indeed, the extent to which paper and paperboard producers can participate in packaging system development may largely influence the industry's future growth or market outlook, as discussed subsequently in this chapter.

Other changes in the business environment driven by e-commerce have also influenced demands for packaging materials. For example, because of smaller order sizes, direct online ordering tends to reduce the demand for wood pallets while creating increased demand for smaller paperboard shipping containers. The shift from mass retail to direct customer delivery of smaller orders through online sales has also increased the demand for protective packaging materials to ensure the safe arrival of goods. The growth of online sales thus offers new market opportunities for the packaging industry.

The most significant industry challenges that global paper manufacturers have faced in recent years are consolidation, globalization, downsizing, and overcapacity (Juslin and Hansen, 2002; *Pulp and Paper North American Fact Book 1998–1999*, 1998). Cyclical demand patterns, high inventories, and variable lead times characterize not only the primary paper and paperboard sector in general but also the paper and paperboard packaging industry because of inefficiencies inherent in the supply chain (Juslin and Hansen, 2002). These inefficiencies are only exacerbated by manual transaction processing and inefficient use of ICT resources.

Economic globalization (partly facilitated by the global Internet) has also been associated with broad structural changes, such as a decline in growth for U.S. manufacturing and expanded growth in goods production abroad (where lower-cost labor or other comparative advantages offer more-efficient production possibilities). The movement of manufacturing capacity abroad (facilitated in part by global management via the Internet and other ICT developments) has tended to reduce local U.S. demand for packaging and local production of paperboard packaging in recent years. For example, U.S. production of paperboard declined in tandem with declining growth in industrial production from the late 1990s to 2001 (*Figure 7.1)*; [Sources: American Forest & Paper Association (AF&PA) and U.S. Federal Reserve].

Providing cost-effective packaging strategies matched to customer needs requires enhanced cooperation and communication between packaging manufacturers and buyers. ICT and e-commerce applications, such as extranets, enable such an improved information flow between global suppliers and buyers and may be used as a platform for more efficient and effective joint product development in packaging and distribution systems. The need to streamline the supply chain and maintain good

[3] Statement attributed to Mack Green, president, Orion Packaging Systems (Anonymous, 2000).

control over operations has become evident throughout the paper industry. Greater integration between primary paper and paperboard packaging manufacturers and their customers further along the supply chain has become of paramount importance, and e-business/e-commerce solutions are available to assist in improving many of these inefficiencies.

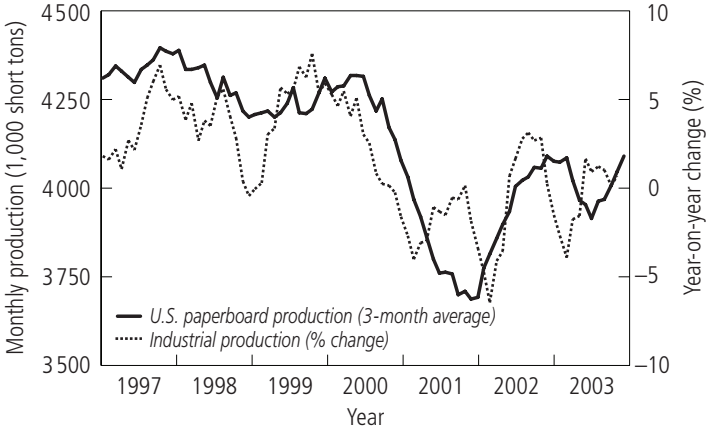

Figure 7.1. U.S. paperboard production and industrial production index (year-on-year growth), 1997–2003.

The Internet also offers a new arena for exchange through online bidding and reverse electronic auctions. Several customer industries of the packaging industry have implemented or tested online bidding. A concern that packaging manufacturers have, however, is their potential to drive down prices and profit margins (Anonymous, 2000). Despite the packaging industry's hesitancy about online bidding, projections indicate that online bidding for packaging products will continue to grow (Toland, 2003). The paper and paperboard packaging industry, as well as any industry facing online bidding in the future, needs to prepare and develop strategies to address business challenges resulting from it. Furthermore, companies that are invited by customers to an online auction will need to develop a strategy for incorporating this activity into existing sales processes.

7.2.3 Opportunities with interactive packaging

Active and intelligent (interactive) packaging is the latest wave of technological advance in the ongoing evolution of paper and paperboard packaging, an evolution in which the opportunity for product differentiation and market development has generally expanded. Paper and paperboard packaging serves a range of functions, including basic functions of containment, protection, or convenience in product handling, as well as more advanced functions, such as providing product information or convenience in product use. In general, paper and paperboard packaging has been evolving for decades from a medium that served only to contain or protect goods in shipment (the traditional functions of sacks, cartons, and boxes) toward a medium that now also provides for distribution of market and product information, and, ultimately, is a means of monitoring the status of product inventory in storage and transit and/or guiding final product use by consumers.

As mentioned previously, this trend owes much of its early impetus to the emergence, in recent decades, of paper and paperboard packaging as an advertising and display medium, with its expanded use of color print and graphic displays. Development of packaging as an advertising or display medium has firmly established a broader role for it in retail marketing. The advent of bar coding on packaging in recent decades has also greatly extended the role of packaging in facilitating transactions and in tracking product inventory, pricing, and sales. However, even decades before the widespread use of color graphics and bar codes, the U.S. military made wide use of packaging for

information transfer, commonly printing packages in World War II with detailed instructions for soldiers on how to use or deploy their contents.[4]

Corrugated containers made from paperboard are the dominant vehicle for shipping goods to market, and most paperboard produced for corrugated containers is still ordinary unbleached (brown stock) that is not intended for color printing or advertising. However, a sizable and expanding market has emerged in recent decades for printed containers suitable for retail display. Thus, the market has already expanded for surface-coated (white-top) linerboard to enable better printing and graphic images on corrugated containers. This development has afforded the opportunity for product-market development and differentiation in the linerboard industry.[5] Similarly, new information technologies are being developed at the present time that are applicable to paper or paperboard packaging, including electronic surveillance, radio frequency identification (RFID)[6], "smart inks," product diagnostics, and polymer or laminar electronics for packaging applications. These technologies also afford new avenues for product development and innovation.

The development of RFID, for example, is rapidly gaining widespread attention in the packaging industry and among large retailers; RFID affords an entirely new and more automated means of inventory tracking and product control. The RFID device is typically a small and inexpensive electronic responder that contains (and may transmit) data on the product contents or other relevant inventory information. With small and inexpensive RFID devices embedded in paper or paperboard packaging materials, product inventories can be quickly assessed and monitored automatically as packages move in and out of warehouses. Some of the larger retail stores in North America have already expressed a desire to switch over to RFID packaging systems.

Wal-Mart has announced its initial RFID implementation rollout to cover shipments from its top 100 suppliers to its six distribution centers and 250 Wal-Mart stores and Sam's Club locations by June 2005; it plans to follow these with more distribution centers and store locations by October 2005, and the next top 200 suppliers are to be included in the RFID implementation plan by January 2006 (Meadows, 2004). According to a Packaging Strategies and Cap Gemini Ernst & Young 2004 survey, more than half (54%) of the surveyed global packaging industry companies believe that Wal-Mart's supplier mandates will be a catalyst for RFID adoption in the industry. Accordingly, half of the respondents (51%) indicated that they are planning RFID implementation programs in 2004 (Patterson, 2004). An example of the packaging industry's response is the cooperation between Stora Enso, a world leader in consumer goods packaging, and Stockway, a specialist Finnish software provider, to develop RFID-based smart-packaging solutions to create added value for customers through improved logistics, better product safety, and online control over the supply chain (Stora Enso, 2004).

Other examples of commercially developed active packaging are food containers that can control moisture content, scavenge oxygen, or otherwise inhibit microbial growth (Brody, 2002). More

---

[4] With instructions printed on packages, it was possible for soldiers to accomplish fairly complex and unfamiliar tasks, such as the processing and development of color photographic film, a type of film that was not in widespread civilian use but became available to military photographers during the war.

[5] Linerboard is the facing material that is combined with corrugating medium (the fluted material) to produce corrugated containerboard for shipping containers and boxes. Linerboard represents a large share of the paperboard industry and is the largest single paper or paperboard product produced in the United States (18 million metric tons of linerboard and 9 million tons of corrugating medium were produced for domestic use in 2001, and several million tons of linerboard were exported) (Source: AF&PA).

[6] RFID is a form of identification that does not require line of sight (unlike bar codes). The RFID system usually includes an antenna (coils), reader transceiver with decoder, and transponder (tag). In operation, the reader sends out a signal, which activates the tag and allows data to come into or leave the transponder's memory. When a tag is within range, the signal from the receiver is sensed and information from the transponder is sent to the receiver. As with most developing "standards," there are several implementations of RFID. See http://www.cknow.com/ckinfo/index.htm

recently, interactive or intelligent packaging has been designed with time–temperature indicators to monitor freshness of food products, electronic sensors to monitor temperature history and shelf life, or chemical indicators to monitor freshness of perishable food (Ahvenainen, 2003). Another example of intelligent packaging is food packaging designed to work with Intelligent Microwave Oven (IMWO) technology, a multipurpose kitchen appliance with product bar code scanning and Internet connection, capable of reading information from a food package to help guide food preparation and cooking (Yam, 2000).

Interactive packaging—which includes active packaging, intelligent packaging, and sensory packaging—takes packaging beyond the realm of enhanced paper or paperboard graphics and into a realm of more-immediate product definition (Dallmeyer, 2003). This kind of packaging can identify, categorize, and sensitize the package in ways that directly connect it to the product for the benefit of the consumer and the consumer-product manufacturer (Dallmeyer, 2003).

Many technological features of interactive packaging have been available for years, but these features are becoming increasingly affordable and applicable with refinements in electronic technology that have recently been the subject of industry trade shows and conferences. Only recently have retailers and producers become poised to exploit these technologies in their supply chain and retail distribution. Developers of interactive packaging technology continue to work on making the technology more commercially viable and cost-effective. It is possible to envision in the not-too-distant future that packages in a retail store will "talk" to the customer, provide the customer with accurate information about product freshness, such as past temperature exposure, allow product purchase without waiting in a checkout line, and also help to ensure that the product is used properly after purchase (such as providing guidance to a customer on how to cook and prepare the contents of a food package with all the perfection of a master chef). However, this vision also implies that the paper and paperboard packaging industry has the potential to evolve from a commodity-oriented industry (like the "containerboard industry") into an industry with products that are more systematically customized and tailored to specific needs (an industry that may become known as the "packaging system industry").

The advance of packaging system technology in the direction of interactive packaging thus affords new opportunities for market development and product differentiation, just as development of enhanced printability and graphic capabilities did in the past; but exploiting that opportunity will depend on how the industry can respond to the challenge of developing entirely new packaging systems. Historically, the industry played a large role in transforming packaging systems through innovations in primary commodity products, such as the development of paperboard technologies that allowed corrugated containers to become the principal medium of goods packaging worldwide. Similarly, the development of printable packaging was chiefly dependent on primary manufacturing and commodity innovations (such as improved print technology, multiply linerboard, sheet-coating technology, and use of more bleached pulp for surface plies). However, the new market-development opportunities afforded by interactive packaging may be more in the areas of secondary system services and end-user support functions (much more of a packaging system service function than a strictly commodity manufacturing function). Thus, the market implications of interactive packaging for the paper and paperboard packaging industry may depend on the extent to which the industry assumes a broader service function and system-development role beyond its more traditional commodity-manufacturing role.

7.2.4 Other e-business developments in paper and paperboard

Apart from the development and application of ICT in packaging, e-business also provides some unique and more general development opportunities in the paper and paperboard packaging industry. The advent of e-business and Internet commerce is seen as promising a range of benefits in manufacturing, particularly in the paper and paperboard sector. However, despite the general enthusiasm, promises, and claims surrounding e-business, a recent survey by consultants PricewaterhouseCoopers revealed that the majority of packaging producers do not yet actually appear to believe that e-business or e-commerce has transformed their industry, although they do believe

that it will do so to some extent in the future (in Toland, 2003). Estimates have been made that e-commerce has a potential to reduce paper industry costs overall by 15% to 20%, the second-highest percentage reduction anticipated among 17 industries studied in 2000 (Fazio, 2000). It would thus appear that the opportunity spectrum for information technology sophistication and e-business development in the paper and paperboard packaging industry is relatively wide. Indeed, some companies within the sector have already established and begun to implement e-business strategies, using fairly sophisticated Internet concepts in their operations. On the other hand, some companies are still rather hesitant to adapt Internet or e-commerce technologies (Shook *et al.*, 2003).

According to PricewaterhouseCoopers (in Toland, 2003), a large majority (82%) of recently surveyed paper companies had an Internet presence. However, their Internet Web sites were primarily informational rather than transactional. As of 2000, only 6% of the companies had product-availability data online and only 3% offered order-status information through their Web pages (pponline.com, 2000; Cubine and Smith, 2001). Among packaging and converting companies, 20% said they offered products and services online, according to a 1999 survey by Packaging Business (Stundza, 1999). The survey also found, however, that a much smaller share of the packaging buyers actually used online sourcing in their purchasing process. The packaging buyers indicated that they preferred dealing with packaging suppliers in traditional ways because of the perceived complexity of their packaging transactions. Another study by PricewaterhouseCoopers found that although two-thirds of packaging-sector companies in the United Kingdom had a Web site and conducted some business through external e-mail, more sophisticated e-business practices remained in their infancy (in Toland, 2003). The study also found that despite 40% of these packaging companies using their Web site to capture customer information, only 14% are actually analyzing it (for example, reviewing purchasing behavior) (Toland, 2003). On the other hand, some case studies have indicated that customer requests were a driving force behind the establishment of online ordering in the paper industry (Friedman, 2000).

Historically, well before the launch of the commercial Internet, paper companies were already reaching out using ICT beyond their organizational limits to create a process of electronic information exchange between vendors and customers. During the 1970s and 1980s, many companies extended ICT beyond the company walls by exchanging data in the form of electronic documents between supply chain partners using system-to-system computer connections over networks and proprietary systems (Chan and Davis, 2000). Since the early 1990s, the paper industry has used an industry-specific message standard for EDI called EDIPAP—Electronic Data Interchange for the Paper Industry (CEPI, 2000). In North America in 2001, approximately 16% of paper-purchase transactions were handled through EDI (Dupuy and Vlosky, 2000). PricewaterhouseCoopers found that 32% of United Kingdom packaging companies used EDI in 2001 (Toland, 2003). The expense, complexity, lack of flexibility, and limited functional scope of EDI implementation has confined its use to large enterprises with large transaction volumes and adequate financial resources (Acly, 2000). The next logical step beyond traditional EDI is the use of the Internet as a modern system-to-system connection platform, eliminating expensive cabling and maintenance costs (Acly, 2000).

Extensible Markup Language (XML) is an emerging Internet standard for sharing data between computer applications that uses the Internet as its platform. The paper industry has made an industry-wide joint effort to develop a set of unified XML messaging standards for business transactions for the buying, selling, and distribution of paper products. This paper-industry-specific messaging standard project is called papiNet (papiNet, 2003). The goal of papiNet is a single set of unified, international XML-based, e-business standards designed to improve the efficiency and accuracy of transactions throughout the paper-supply chain, while reducing the cost of operations (papiNet, 2003). Development of industry standards that will enable efficient transactions between customers and suppliers, and prevent fragmented and costly e-commerce infrastructure, is a critical part of the foundation for e-business (CEPI, 2000).

Paper industry vertical business-to-business (B2B) exchanges, also called e-marketplaces, were established to help the industry decrease inefficiencies in their supply chains and better cope with the cyclical nature of industry markets through better visibility. There has been a positioning of e-marketplaces in the supply chain by firms' claiming to offer the opportunity of lowering the transaction costs of identifying, negotiating, and purchasing from multiple suppliers, as well as providing access to consolidated pricing and industry demand/supply information. As users are able to browse suppliers' or buyers' aggregated inventories and/or production schedules, they can improve production planning, reduce inventory, and implement dynamic pricing arrangements.

As was the case in other industries, the paper and paperboard packaging industry saw the emergence of e-marketplaces around the dawn of the new millennium. In 2000 more than 50 "dotcoms"—Internet enterprises—were competing to capture market share of paper industry revenues (Hayhurst, 2001). Certain characteristics of the paper and paperboard packaging industry, such as the high degree of fragmentation, highly cyclical and unpredictable supply and demand, and multiple distribution steps, almost guaranteed the suitability of e-marketplace development for the industry (Moore, 2002). Thus, according to the PricewaterhouseCoopers 2001 Global Forest & Paper Practice estimates, 25% of U.S. forest product industry revenues were expected to be transacted over the Internet and 12% in e-marketplace sales by 2004 (*ForestExpress*, 2001). However, despite the positive prospects, B2B exchanges were unable to achieve that kind of success. After the economic slowdown and the dotcom crash in 2002, only a few vertical e-marketplaces for paper remained in business (Kallioranta, 2003). Yet, in 2001, 25% of surveyed United Kingdom packaging manufacturers claimed access to a B2B e-marketplace (Toland, 2003).

While the market has witnessed the demise of third-party e-marketplaces (dotcoms), it has experienced a growing interest in private exchanges and "extranet" solutions. Extranets started to gain interest and enthusiasm among businesses in the later half of the 1990s. In 1998, 13% of the companies surveyed in a cross-industrial study by ActivMedia Inc., said they had implemented an extranet (McCune, 1998). In the same year, 10% of forest-industry companies surveyed in North America indicated extranet implementation (Vlosky and Punches, 1999). Less than 10% of packaging producers claimed to have their own extranet in the United Kingdom in 2001 (Toland, 2003).

7.3 Alternative Hypotheses and Future Scenarios

The following sections discuss several alternative hypotheses regarding the broad impacts of ICT and e-business in the paper and paperboard packaging industry. The hypotheses lead to several speculative scenarios regarding impacts of ICT on paper or paperboard commodity markets. The idea is to generalize discussion of ICT and e-business development: 1) by considering what could happen to primary paper or paperboard commodity markets as ICT developments expand in the future, and 2) to provide a basis for speculative discussion of broader implications for the forest sector.

Currently available data on ICT developments cover only a relatively short time frame. Nevertheless, using a market model framework as a basis for discussion, it is possible to discuss different hypotheses in some detail in terms of speculative market scenarios. Discussion of hypotheses and scenarios leads to some recommendations regarding the research needed to fill knowledge gaps, how to improve existing market models in order to evaluate ICT impacts, needs for alternative models and market interpretations, and suggestions for research on how to identify and take full advantage of ICT and e-business applications in the context of competitive corporate strategies

7.3.1 Market-expansion scenario

One broad hypothesis is that the emergence of interactive packaging systems coupled with widespread use of e-commerce offers potential for expansion of packaging markets through

development of new electronic packaging systems. Just as evolution of paper and paperboard packaging from basic container functionality to print-and-display functionality has led to new demands for packaging in recent decades (to communicate and provide more product information to customers), so too could the evolution from printed information on the package to electronic information in the package.

Trends in interactive packaging technology suggest that future packaging systems will be able to convey a much wider array of product information to customers and thus enhance the utility of packaged goods, courtesy of inexpensive electronic components embedded within the packaging itself. Several decades ago, the role of packaging was mainly limited to functions such as delivery of goods to stores in brown corrugated boxes. Today, much more colorful packaging containers serve also to provide customers with vital product information, often with pictures or printed instructions on how to handle or use a product. Not long from now, interactive packaging may "talk" to customers, telling them more about the condition of the product or how long it has been on the shelf, and also providing customers with the latest information on how the product can be used optimally for various purposes, augmented by updated information transmitted to the package from an electronic network.

This hypothesis suggests a scenario in which the packaging industry will expand into value-added markets by developing entirely new packaging services that increase the demand for or the value of packaging in general. The market-expansion scenario envisions that the paper and paperboard packaging industry is entering a new era of market development, with expanded potential because of extended service functions (beyond the traditional roles of packaging) and also because interactive packaging can increase the utility of packaged products. Under this scenario, the utility of paper and paperboard packaging (as well as the packaged products) could be significantly enhanced by interactive packaging systems. The economic value of paper and paperboard packaging could increase if producers capture (at least, in part) the value associated with the development of improved packaging systems. In effect, the paper and paperboard industry of the future may be able to boost demand for packaging materials (as they have in the past) and also capture additional value for new packaging system services (to the extent that they retain a proprietary service role in packaging-system development or maintenance).

Thus, the market-expansion scenario suggests that interactive packaging will expand markets and enhance product value for paper and paperboard packaging, as the industry participates in the advent and exploitation of the new interactive packaging systems of the future. That this outcome will actually occur remains largely speculative, but one purpose of this chapter is to develop speculative scenarios concerning the potential role of ICT and e-business development in the industry.

The short-term impact of the market-expansion scenario can be introduced using a static equilibrium model. One common way of illustrating the market context for primary paper or paperboard packaging producers (for example, the paperboard industry within a particular region) is to plot data on mill capacities and the production costs of mills in ascending order, yielding a marginal production-cost curve (or supply curve) that can be viewed as intersecting a product-demand curve for all producers. *Figure 7.2* is a stylized illustration of this concept of static market equilibrium, where the upward-sloping "capacity–cost" curve (or product-supply curve) intersects the downward-sloping demand curve at equilibrium price (P_1*).

In *Figure 7.2* the letters (A, B, C, etc.) denote individual mills, with production capacity and production cost for each mill indicated by the width and height of each vertical bar. The stepwise upward-sloping "curve" formed by the bar chart of capacity and cost data is the industry marginal cost or product-supply curve (*Figure 7.2*). Assuming that the industry operates in a competitive market and that output capacity is met by product demand, the market equilibrium (the balance between supply and demand) occurs roughly at price P_1*, where marginal costs of production (of the highest-cost producer) equal marginal price (willingness to pay by consumers).

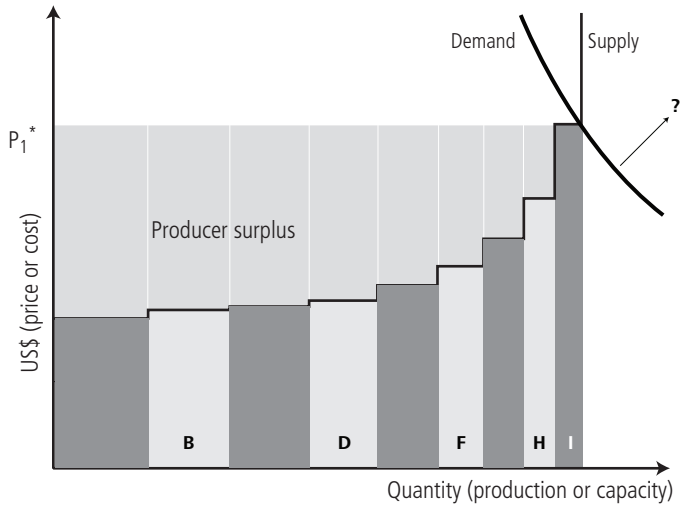

Figure 7.2. Static equilibrium model of the paperboard industry, with individual mills (denoted by letters) having varying capacity (*x* axis) and production costs (*y* axis).

The area between the price line and the industry cost curve is producer surplus (the source of industry profits), with lower-cost producers having generally higher profit margins. In general, the market equilibrium may also settle at a different point, either at a higher price if there is excess demand or at a lower price if there is excess supply (or excess capacity). Thus, price and producer surplus (or industry profit) can vary, depending on cyclical market conditions. However, here it is sufficient to simply recognize that the production costs of various producers, the overall level of product demand, and the willingness to pay for the product (or product services) each play a role in determining the overall market equilibrium and the profits of individual producers.

The market-expansion scenario suggests that interactive packaging systems will boost overall product demand or overall product value, shifting the packaging-demand curve upward or outward and increasing both price and producer surplus for paper and paperboard packaging. That scenario lends a positive or optimistic outlook to the future implications of ICT and e-business development in the paper and paperboard sector. However, precise impacts on demand and prices are at best speculative, and benefits to primary paper and paperboard producers will depend on how successful they are in garnering value from packaging system development. Thus, there is a speculative potential for increased demand, but the precise shift of the demand curve remains a question mark (*Figure 7.2*).

The market-expansion scenario and static equilibrium model suggest some knowledge gaps and future topics for research. The impact of interactive packaging on overall paper or paperboard demand is one obvious question raised by the scenario. Another related question is whether some firms will gain competitive advantages over other firms via ICT development. Carr (2003) argues in his widely debated Harvard Business Review article that investments in ICT are less and less likely to deliver competitive advantage to firms over time as the power, ubiquity, and affordability of information technology grow. His argument was based 1) on the comparison of information technology as a so-called infrastructure technology with a variety of other ubiquitous infrastructure technologies, such as steam engines, railroads, electricity, and telephones, and 2) on the belief that a firm can gain competitive advantage only by having something that rival firms do not have. Carr noted that ICT did provide innovative first-mover companies with many opportunities for competitive advantage early in the ICT "build out" curve, "when it still could be owned like a proprietary technology."

In contrast to Carr's view, others have argued that the competitive advantage rests not in ICT itself but in the firm's capabilities to use it. Although ICT may have become ubiquitous and readily available, the insight and ability required for it to create economic value and competitive advantage

are very much in short supply (Stewart *et al.,* 2003). Brown and Hagel (2003) (in Stewart *et al.*, 2003) reason that competitive advantage is based more on the ability to innovate around the continually evolving capabilities of ICT than on technical or business-practice innovation at any point in time.

In the case of interactive packaging, the rate of diminishing returns from ICT investments, suggested by Carr (2003), may depend on whether a firm is vertically integrated or not, or whether a firm is a primary paper or paperboard commodity producer or a secondary converter (a producer of packaging end products). The ongoing development of interactive packaging technology suggests that vertically integrated firms or converters who produce packaging end products will likely have a greater ability or more opportunity to develop new and innovative packaging systems, reaping most of the economic benefits of innovation, whereas those who are only primary paper or paperboard commodity producers may not reap the same immediate benefits from product innovation, apart from a potential for long-term expansion in overall paper and paperboard commodity demand.

The equilibrium model also suggests a need to focus on how ICT will influence competitive advantage and production costs among individual firms or competitors in the industry and the question of what might happen in the market if some firms become leaders in the development of ICT or e-business systems. Those questions lead to the following two additional scenarios related to the potential market impacts of e-business or e-commerce.

7.3.2 Cost-saving scenario

A much more conventional hypothesis concerning e-business systems is that they will reduce overall industry operating costs and therefore increase profitability. This is a reasonable hypothesis (although not entirely certain, as such systems have yet to become fully implemented throughout the industry). By scheduling production orders more efficiently via e-business, normal business and production operations can in theory become more cost-efficient. Another potential cost-saving aspect of RFID tags on packages could be to increase recycling efficiency by helping to automate the sorting of recycled packaging materials (Saar and Thomas, 2003). The general idea that ICT and e-business can enhance production efficiency leads to a "cost-saving scenario," in which packaging production costs of primary paper and paperboard producers and secondary converters decline, as e-business affords a more efficient and instantaneous linkage of customers and overall production scheduling.

In general, a firm that is an early entrant to e-commerce or manages e-business more efficiently than other firms may achieve some short-term market advantages or greater cost savings than other firms. However, in theory, there is no reason not to expect all producers in a particular commodity market, such as paper or paperboard packaging producers, to quickly take full advantage of e-business and all firms to eventually experience similar production efficiencies and cost savings. Carr (2003) would appear to be an advocate for the latter idea. He claims that by the time the market becomes saturated with ICT infrastructure, the opportunity available for individual-firm competitive advantage will largely be dissipated.

Under this interpretation, it seems plausible that wide-scale adoption of e-business would simply result in long-term, across-the-board reductions in costs (cost savings) for all producers in a particular commodity market, such as paper or paperboard packaging. Furthermore, in the long run, gains in production efficiency could result not only in industry-wide cost savings but also in a deflationary reduction in product price, which may ultimately erase temporary gains in producer surplus or gains in profitability for early entrants. On the other hand, research by Strassmann (2003) and other authors in Stewart *et al.* (2003) shows that firms using identical information and communication technologies and demonstrating equivalent ICT spending have great variability in profitability. In addition, Strassmann (2003) points out that profit potential depends on whether firms adopt individual custom combinations of available applications and software offerings instead of installing comprehensive, generic, enterprise solutions.

Market impacts of the "cost-saving scenario" under Carr's interpretation of long-term market outcomes can also be illustrated using the static equilibrium model. The impacts on market

equilibrium of an industry-wide (across-the-board) cost reduction are shown in *Figure 7.3*. The cost reduction shown in *Figure 7.*3 is stylized and perhaps exaggerated for illustrative purposes (the precise future cost savings resulting from e-business remains speculative). However, in general, the anticipated outcome under this scenario is that the overall commodity supply curve (cost curve) would be pushed downward because e-business is interpreted as having the long-term effect of overall cost reduction. As long as capacity remains constant (and assuming that demand is at the limits of capacity in this case) the short-term market impact would be to increase overall producer surplus or profitability in the industry. However, according to economic theory, this effect would not last for long, as the market equilibrium price would equilibrate downward toward the lower marginal costs of the marginal producer (the demand curve would deflate downward as competitive buyers learned that products were available at lower costs).

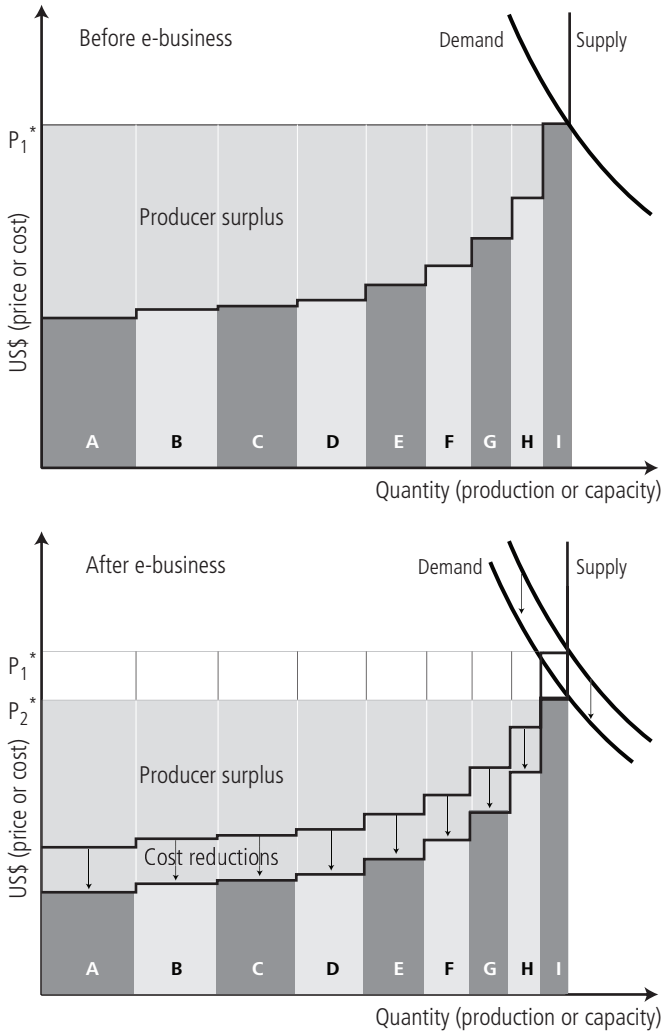

Figure 7.3. Market impacts of e-business in a commodity market, assuming the primary effect is to reduce operating costs.

Thus, as shown in *Figure 7.3*, the net outcome of industry-wide cost reduction is likely to be deflationary (price shifting from P_1* to P_2*), although precise long-term impacts are ambiguous. Impacts on producer surplus or profitability for individual producers will depend on the level of cost reduction afforded by e-business for marginal and efficient producers. For example, if the marginal producer (mill I in *Figure 7.3*) were to achieve greater-than-average cost savings from e-business, the market price could drop significantly and the effect of e-business would be to reduce profitability

across the entire sector. The long-term impact on producer profits might be alternatively neutral or even positive, but that would depend on whether cost savings at individual firms outweighed deflationary impacts on market price and also on long-term capacity adjustments. Although the impact across the entire industry on producer surplus or profitability under this scenario is somewhat ambiguous, the market model points to a need for a better understanding of the existing cost structure of the industry and the true cost-savings potential of e-business and e-commerce as necessary elements in appreciating the long-term market impacts of the cost-saving scenario.

In addition, although the static market model (*Figure 7.3*) may be appropriate as a framework for discussing the market impacts of overall reductions in operating costs (such as greater efficiencies in production scheduling or supply chain cost savings), the static model may be a poor framework for illustrating differences in transaction-cost savings among individual firms (such as the effect of more efficient matching of buyers and sellers to individual firms via e-commerce). A more sophisticated market model may be needed to take into account the commercial arbitrage process between buyers and sellers in cases where transaction costs are being reduced by e-commerce, because it is not immediately apparent whether the transaction-cost savings will accrue to the buyer or to the seller. In an extreme case, suggested by the following scenario, not only may buyers obtain significant transaction-cost savings but e-commerce may also conceivably result in market segmentation, which could result in the shift of a considerable amount of producer surplus from sellers (primary producers of paper and paperboard) to buyers (secondary converters or packaging customers).

7.3.3 Market-segmentation scenario

A somewhat different hypothesis concerning the development of e-commerce in the pulp and paper sector is that it will reduce not only production costs but transaction costs in general. Hypothetically, e-commerce may promote a better or more optimal match between secondary converters and primary paper or paperboard producers. For example, paper or paperboard mills typically produce large bulk rolls of paper in various roll widths (so-called trim widths), and converters (buyers of bulk rolls) typically have various roll-width needs and specifications. Paper-roll trim optimization and special invoicing have been cited as advantages of e-commerce in the paper industry.[7] Buyers of finished rolls are converters whose roll-width requirements vary with the requirements of their converting operations and customer needs, while sellers are mill operators who may have to adjust width settings of roll slitters and handle excess trim loss. E-commerce can help match buyers who want a particular trim width with sellers who can most efficiently produce that particular trim width, and vice versa, and thus e-commerce may reduce transaction costs. However, whether the economic surplus generated by such transaction-cost savings in general will accrue to buyers or to sellers in the market remains ambiguous.

An extreme case that illustrates a loss of producer surplus is market segmentation, where primary producers who once shared a common commodity market become segmented into smaller markets with less overall producer surplus. A "market-segmentation scenario" may seem unlikely in the case of commodity packaging grades of paper or paperboard. It could nevertheless occur if e-commerce is able to achieve transaction-cost savings by better matching buyers to sellers according to product parameters, such as paper or paperboard roll width, and thus afford economies to buyers with different sheet-width requirements.

The underlying hypothesis is that transaction costs may decline, as e-business will afford instantaneous linkage and virtual integration between sellers and buyers, while business operations and production scheduling will become more efficient. However, the "market-segmentation scenario" suggests that e-commerce will also bring about a structural shift in purchasing power from sellers to buyers. According to e-commerce experts such as Bradley Rosencrans (see Cody, 2000), the market and the customer will drive transactions in the world of e-business, creating a new business model called "demand-pull" (demonstrated as a business model by the Dell Corporation, for example) as

[7] See *Pulp & Paper* magazine, February 2000 and August 2003.

opposed to the traditional "production-push" (or cost-leader) business model of the commodity-based pulp and paper sector. In this new model, the effect of e-business will be to redesign business transactions from the customer backward and not from the mill forward, by allowing buyers to identify more efficient transactions via the Internet.[8] According to this hypothesis, new and more-efficient market segments could emerge as a result of e-commerce or e-business.

Using the example of specification of trim width in finished paper or paperboard rolls, it is possible to envision that more efficient markets for buyers may turn out to be more segmented (smaller, more customer-oriented markets, as opposed to larger, mass commodity markets). As suggested earlier, e-business could more efficiently match buyers (converters) who want a particular roll width to those producers (mills) that can most efficiently produce that particular roll width, and vice versa. Whereas, in the past, the transactions of mass commodity brokers have tended to unify commodity markets around standard product grades, the effect of placing individual buyers into direct contact with producers via e-commerce could lead to market segmentation. Apart from transaction-cost savings, better matching of buyers and sellers may result eventually in the segmentation of the market into submarkets, that is, niche markets (according to roll width, for example).

ICT also has the potential to lead to geographically expanded markets as the importance of physical proximity diminishes because of business use of the Internet or other electronic communication technologies. This might contribute to the enhanced profitability of new submarkets or niche markets as well as to expanded global enterprise development. Internet and ICT communication technologies are, for example, helping to advance the outsourcing of production capacity throughout manufacturing to low-cost regions of the world and to facilitate global integration of business relationships. With advanced and instantaneous communication technologies to transmit customer orders and even product design specifications, manufacturers in formerly remote regions of the world, such as China, for example, can readily exploit niche-market opportunities and satisfy custom product orders for clients on the other side of the globe. The opportunity for more customized or segmented niche markets in packaging is thus greater than ever before.

When market segmentation occurs in a previously unified commodity market, the theoretical economic outcome is a net loss of producer surplus. *Figure 7.4* shows a stylized illustration of this effect for an extreme example of market segmentation (or market fragmentation), in which two different markets emerge: one for the products of larger mills and another for the products of smaller mills (for example, mills producing larger rolls and mills producing smaller rolls). The effect of such market fragmentation on producer surplus appears unambiguously negative based on the static equilibrium model.

However, as the shapes of industry capacity–cost curves vary by geographic region around the world, the magnitude of impact could also vary globally (for example, between the more diverse cost structure of mills in the historically more-developed North and the newer and less diverse mills in parts of the developing South). The market model for this scenario suggests the need for a better understanding of the regional cost structure and potential for market segmentation in order to evaluate the market effects of more-efficient e-commerce transactions. It can also be noted that the static equilibrium model discussed in this chapter is a highly simplified representation of market behavior. For example, the static equilibrium model has an implicit but also perhaps questionable assumption of perfectly competitive behavior—producers will produce up to the level of production where marginal revenue equals marginal costs of production. Instead, in the face of lower profits (or reduced producer surplus) producers may simply withdraw production capacity from the market (for example, shut down older or less efficient mills), a behavioral response that would complicate efforts to model the market impacts of transaction-cost savings through e-commerce.

---

[8] See *Pulp & Paper* magazine, February 2000.

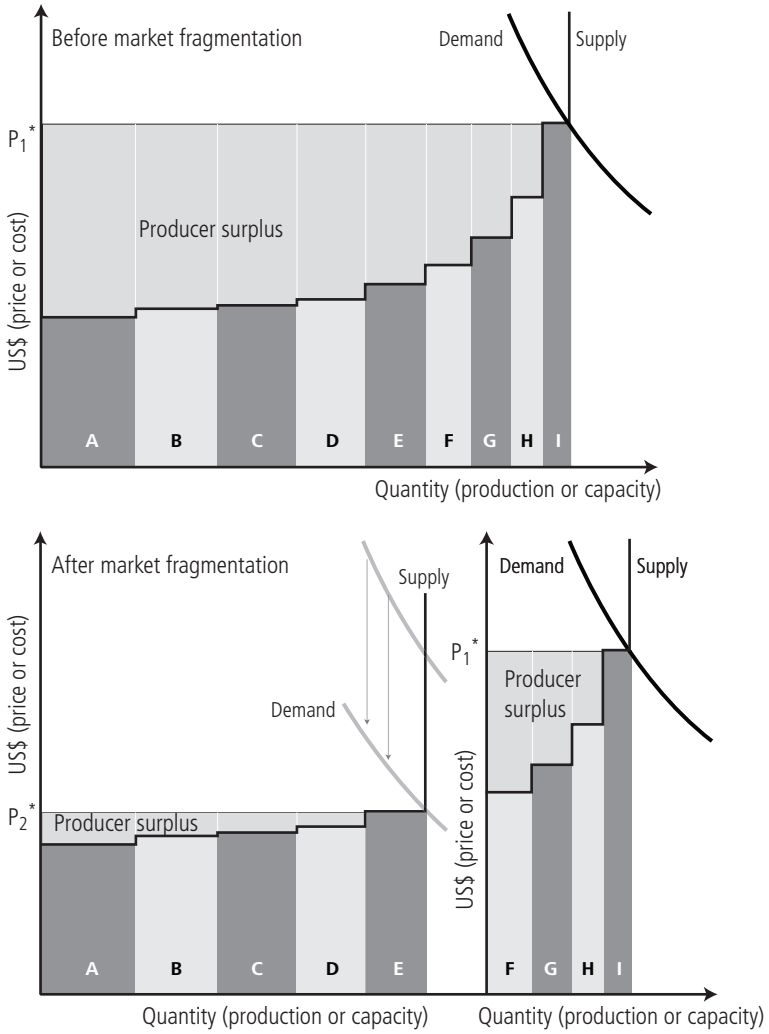

Figure 7.4. Loss of producer surplus in an extreme case of market fragmentation, assuming no change in overall production capacity or consumption levels.

Transaction costs can also be viewed more broadly to encompass challenges in building relationships and trust, and dissemination of knowledge. Accordingly, Pike (2003) contends in Stewart *et al.* (2003) that whereas information technologies gave rise to improvements in productivity in the 1980s and 1990s, information and communication technologies in the new millennium enable suppliers, producers, and customers to integrate their business processes and value chains, acting as if they were one company by sharing information on inventories, production, demand forecasts, and even costs and prices. Thus, ICT may change the way businesses in the paper and paperboard packaging industry work together; and it may have the potential to reduce transaction costs, increase efficiency, and expand markets more broadly.

7.4 Discussion

Three speculative scenarios have been advanced. These are primarily for the purpose of providing some visionary discussion about various hypotheses related to impacts of ICT and e-business development in the commodity-oriented paper and paperboard packaging industry. However, their aim is also to point out knowledge gaps and the need for research in specific topical areas (an objective of the IUFRO Task Force on ICT in the Forest Sector). The three speculative scenarios are summarized as follows:

- Market expansion (via interactive packaging);
- Cost saving (via e-business and more efficient production); and
- Market segmentation (via e-commerce and reduced transaction costs).

The relative likelihood of market outcomes under these scenarios is unknown, and only weak empirical evidence supports such scenarios, indicating to some extent those areas where there are knowledge gaps. An interesting aspect of any discussion is how to fill the knowledge gaps in order to examine whether these scenarios or their underlying hypotheses may be valid or invalid.

The first scenario derives from the hypothesis that ICT and market development associated with new interactive packaging technology will expand markets and increase product demand. Although, conceptually, this appears to be a promising hypothesis that offers a potential for increased product demand or new pathways for paper or paperboard packaging development, only limited experience and largely anecdotal information are available to test the hypothesis over the long run. Although it can be suggested that development of interactive packaging offers the paper and paperboard industry an opportunity to shift their business strategies from the commodity-based, cost-leader strategy to a more market-oriented strategy based on packaging system development, that opportunity is largely speculative (and has yet to be fully exploited). Considerable research and observation of product- and market-development trends will be needed for the ultimate market implications of this development for the paper and paperboard sector to be understood. There is also a fundamental question as to whether the existing commodity-oriented paper and paperboard industry can evolve rapidly enough to assume new service functions or new product-development roles that are implicit in the development of new interactive packaging systems.

The second and third hypotheses (concerning cost reduction and market segmentation) suggest the possibility of a reduction in producer surplus and thus some deflationary or disruptive market impacts in the commodity-based paper and paperboard packaging industry resulting from the advance of ICT and e-commerce. Indeed, the general retreat of independent e-commerce enterprises that has occurred in recent years (the decline of the dotcoms) is sometimes erroneously interpreted to mean that e-commerce may have somewhat less-promising financial benefits than previously anticipated. However, the demise of dotcoms (usually small, independent firms) should not be construed as the demise of ICT itself. ICT had enabled the start-up of many small intermediate dotcom firms in the late 1990s. These, however, were not the sole manifestation of ICT, and indeed, statistics show continued growth in the volume of e-commerce and e-business.

The broad industry interest and headlong advance of e-business and e-commerce in the paper and paperboard industry suggest that decision makers within the industry must anticipate economic advantages that are expected to cancel or offset any potential deflationary or disruptive impacts on markets. Although there are many insights into the motives for ICT and e-business development in the paper and paperboard sector (as discussed previously), significant knowledge gaps remain about collective or long-term market consequences of such development.

7.4.1 Globalization/location implications

ICT, e-commerce, and e-business development has potentially divergent economic implications for globalization and the location of future forest sector development, either accentuating or attenuating shifting patterns of global capacity growth in the paper and paperboard sector. At the broadest level, ICT and the Internet enhance global commerce and global business communication, helping facilitate globalization of commerce and industry. Barriers to trade have fallen rapidly over the past decade along with expansion of e-commerce and ICT. Innovations in communications, computing, production-control systems, and distribution have accelerated the design, production, and delivery of goods on a global scale. Automated production processes have spread rapidly throughout the world. In recent years, economic globalization has contributed to a shift of growth in pulp and paper capacity from developed countries (such as the United States) to other countries, including low-income countries in Asia, such as China. For example, U.S. exports of packaging grades of paperboard to China, once the leading U.S. export destination for paperboard, have declined in recent

years, as packaging paperboard production capacity and industrial output have expanded in China. As mentioned previously, U.S. output of paperboard has declined in recent years along with a decline in overall U.S. industrial output (see *Figure 7.1*).

Many factors besides ICT and the Internet are responsible for the expansion of capacity in countries like China (such as low labor costs, expanded growth and foreign investment, and government subsidies). However, the economic experience of the forest sector of the United States during this period of economic globalization provides some empirical evidence of how the forest sector can be impacted negatively by structural change (such as the shift of growth in manufacturing and paperboard production to China), which has been facilitated to some extent by global interconnectedness, the Internet, and ICT.

Under the first scenario, discussed earlier, ICT offers the potential for an expanded and more lucrative market development in packaging (via new interactive packaging systems, for example). Under that scenario, development might be expected to occur most rapidly in regions or countries with the most highly advanced commercial infrastructure and capability (North America, Europe, or Japan, for example), able to readily adopt new electronic packaging systems that can communicate with customers, such as via cell phones. This suggests an advantage under that scenario for paper or paperboard firms in the historically more developed North versus the developing South. Nevertheless, ICT and e-business technologies are easily transferred and readily adopted elsewhere. In China, for example, there are currently more cell phones in use than in any other country. (*United Press International* reported on 25 August 2004 the announcement by China's Ministry of Information that the country had 310 million mobile phone users as of the end of July 2004.)

Under the second scenario, ICT is primarily a cost-saving development with the likelihood that, in the long run, all firms in the industry will eventually exploit the same or similar cost-saving advantages. On the other hand, recent research has shown that firms using identical information and communication technologies and demonstrating equivalent ICT spending have great variability in profitability. Without more specific evidence, whether gains will be higher in one global region or another remains ambiguous. However, it has certainly been observed in recent years that paper and paperboard producers in regions with high-yield wood-fiber plantations (such as Latin America or Asia) or in low-income countries (such as China) have significant manufacturing-cost advantages and high rates of economic growth, both of which have attracted a larger share of global capital investment and capacity expansion. As new plants thus tend to be larger and more efficient in those regions, adoption of the cost-saving advantages of ICT might serve to accentuate their competitive advantages (and certainly e-business and e-commerce systems are widely available on a global scale and just as likely to be adopted by firms in Asia or Latin America as in Europe or North America).

Under the third scenario, ICT may result in market fragmentation, and a significant loss of producer surplus may occur (as illustrated in *Figure 7.4*). That loss is potentially greater in regions where the cost structure of the industry has greater diversity (where there is a wider range of production costs among firms or plants in the industry). The plant infrastructure of the pulp and paper industry in developed regions of the world is typically varied in age and size of production facilities (and therefore more diverse in cost structure). Some older mills in North America or Europe, for example, have been in operation for decades or generations, although a number of leading firms in Europe and North America have a reputation for reinvestment and continuous improvement of existing production facilities.

Conversely, the cost structure of the industry tends to be newer and less diverse in some developing regions (such as some countries in Asia or Latin America), where the plant infrastructure is more modern and there are fewer older mills in operation. In China, however, there is a unique combination of many older and less-efficient mills plus rapid expansion, with many larger and more-efficient mills having been built in recent years. In any case, a market-fragmentation scenario would likely have less economic impact on producer surplus in regions with a preponderance of newer mills with less diversity in cost structure and more economic impact in regions with a more diverse cost structure (a wider range of newer and older, less-efficient mills).

7.4.2 Implications for forestry and forest resources

The three hypothetical scenarios outlined above also have divergent implications for forestry and forest resources. In general, the experience of forest resource development throughout the world in recent decades indicates that forestry and forest sector development becomes more economically feasible and is more likely to be sustainable when the local forest industry infrastructure undergoes stable and prosperous economic development. On the other hand, when producer surplus and profitability decline, forestry and forest-resource development tend to suffer setbacks.

For example, since the mid-1990s, producer surplus and the profitability of the U.S. pulp and paper industry have declined (reaching a cyclical low point in 2002, following the all-time historical peak in 1995). The decline in profitability of the industry, associated in large part with the economic globalization of manufacturing, contributed to a significant historical decline in average U.S. pulpwood prices (real pulpwood prices dropped by about one-third from 1997 to 2002, according to the U.S. Bureau of Labor Statistics' nationwide pulpwood price index). Furthermore, the gross economic output of forestry in the United States peaked in 1994, when U.S. pulpwood receipts peaked, and then subsequently declined by 29% from 1994, as pulpwood receipts and pulpwood prices declined.[9] Clearly, the trends of the past decade indicate that when profitability in forest industry declines (such as in the pulp and paper sector of the United States in recent years), the forest sector and forestry also tend to suffer economically. The number of professional foresters who are members of the Society of American Foresters, for example, has declined by about 15% since the mid-1990s, a decline that roughly matches the decline in pulpwood receipts at U.S. pulp mills since the mid-1990s.

Under the market-development scenario, ICT could lead to a more economically vibrant paper and paperboard sector, with potential outcomes such as increased product value and expanded markets as a result of the development of new interactive packaging systems. Expanded producer surplus in that case could result in increased financial stability and therefore increased capability to support industrial forestry and sustainable forest management; but that outcome, as noted previously, remains speculative.

Moreover, in recent decades, as noted earlier, significant changes were made in paper and paperboard production to facilitate greater use of packaging as a communication and marketing medium, with, for example, increased output of printable (white top) linerboard for corrugated containers or other printable packaging materials (such as increased output of coated boxboard). Those technological developments have had some marginal impacts on roundwood raw material needs in the packaging paper and paperboard sector. Decades ago, unbleached kraft linerboard and boxboard were produced almost exclusively from softwood species (which have longer fibers than hardwoods and provide superior strength properties important in packaging). However, expanded production of printable grades of paperboard coincided with increased use of hardwood fiber (which can provide a good printing surface) and also greater use of surface coatings (e.g., clay coatings or fillers) that have to some extent offset the use of softwood fiber.

The likely long-term impact of interactive packaging technologies on wood-fiber demand is unclear. At present, interactive-packaging and electronic-communication technology is not yet a complete substitute for print communication on packages. However, in contrast to the resource-use trends of recent decades, it is at least conceivable that future interactive-packaging and communication technologies could replace printing as a communication medium in packaging, potentially resulting in a reversion to less use of clay coatings or hardwood fiber in paperboard packaging (materials that improve printability) and increasing the use of softwood fiber (which tends to improve strength).

---

[9] The gross output of forestry is an element of U.S. GDP (part of the forestry and agriculture component of the U.S. National Income and Product Accounts).

Under the cost-reduction scenario, e-commerce and e-business systems would result primarily in operational cost savings and increased producer surplus in the short run, at least for those firms that are early exploiters of the cost savings derived from ICT or e-commerce and e-business systems. However, theoretically, product prices will eventually equilibrate to lower marginal costs of production if all firms in the industry are able to gain the same benefit from the readily available technology (*Figure 7.3*). The net result in terms of producer surplus in that case is ambiguous, and thus the potential longer-term benefit to forestry or forest sector development is likewise ambiguous under the cost-saving hypothesis.

Under the third scenario, ICT and e-commerce may lead to some segmentation or fragmentation of large unified commodity markets (which were historically characteristic of commodity markets in the paper and paperboard sector). In that case, an unambiguous result would be a reduction in producer surplus and hence a likely reduction in industrial support for forestry or sustainable forest management.

7.4.3 Research tasks

For IUFRO and forest sector researchers who are interested in global forest sector development, forest sector markets, or forest sector modeling, the emerging role of ICT and the hypotheses discussed in this chapter present a set of concrete research tasks. One of those tasks is to assemble data to provide better quantitative measures of the expansion of ICT in the paper and paperboard industry.

For example, there are copious amounts of historical market data on the tonnages of paper and paperboard production, consumption, and trade, as well as data on prices and production capacities. However, there are very scant market data on precisely how much paper or paperboard is used for intelligent or interactive packaging (such as packaging with RFID), how rapidly the market is changing, or how much of a price differential exists for such packaging. As with any new or emerging technology, there are data gaps that need to be filled. Creative research may help in the design of interim measures or proxy indicators for such data. For example, the number of electronic RFID devices produced annually may be known with some certainty, and, if so, an approximation of trends in the volume of interactive packaging output might then be derived.

Once relevant market data are assembled, another research task will be to construct behavioral market models that may eventually be used to test the market hypotheses discussed previously. Many factors have historically influenced structural change in markets for paper and paperboard packaging. For example, shifts in waste-disposal policies and the increased costs of waste disposal in recent decades have helped to make paper recycling more economical and have led to substantial increases in the use of recycled fiber in paper and paperboard packaging. Economic models were designed to evaluate the behavioral response of paper recycling to increasing waste-disposal costs. Widespread introduction of RFID in packaging could further increase efficiency in the recycling industry by affording a more efficient means of automated sorting and handling of recycled packaging materials (Saar and Thomas, 2003). Similarly, economic models can be designed to simulate the market response to the cost advantages or expanding market demands for intelligent or interactive packaging systems.

Perhaps most importantly for the forest sector, researchers can undertake the task of extending such models to examine the business-welfare and forest-resource-value implications of ICT development, testing which of the preceding hypotheses may be rejected and which not, based on more empirical models and behavioral evidence. When such models or evidence become more widely available, it will be possible to better identify the broad market advantages of ICT and, in that context, develop more competitive corporate strategies.

7.5 Conclusion

This review of ICT and e-business developments in the paper and paperboard packaging industry, including the outline of speculative market scenarios, leads to recognition of certain knowledge gaps and recommendations for IUFRO concerning research needs in this topical area. Knowledge gaps include a lack of clear and comprehensive understanding of how ICT and e-business developments will influence markets for paper and paperboard products, such as how the emergence and development of interactive packaging will affect markets for primary paper and paperboard packaging materials and whether it will afford new opportunities for market development. Recommendations include: 1) the development of better empirical market models that more comprehensively evaluate the market impacts of ICT and e-business developments in the paper and paperboard sector, and 2) research on how to identify and take full advantage of ICT and e-business applications in the context of competitive corporate strategies.

References

Acly, E., 2000, *Business Exchange Automation: Reengineering The Rules of E-Business,* White Paper, NextSet Software Inc. See http://b2b.ebizq.net/ ebiz_integration/acly_1a.html (Last accessed August 2002).

Ahvenainen, R., 2003, *Novel Food Packaging Techniques,* CRC Press, Abington Hall, Abington, Cambridge, England, p. 400.

Anandarajan, M., Anandarajan, A., and Anandarajan, J.W., 1998, Extranets: A tool for cost control in a value chain framework, *Industrial Management & Data Systems,* 98(3): 120.

Anonymous, 2000, Hot new trends in packaging, *Modern Materials Handling*, 55(11): 3.

Armstrong, C., and Sambamurthy, V., 1999, Information technology assimilation in firms: The influence of senior leadership and IT, *Information Systems Research,* 10(4): 304.

Bharadwaj, S., Varadarajan, R., and Fay, J., 1993, Sustainable competitive advantage in service industries, *Journal of Marketing*, 57(4): 83–100

Brody, A.L., 2002, Action in active and intelligent packaging, *Food Technology*, 56(2): 62–67.

Brown, J.S., and Hagel, J., 2003, Letters to the editor, in T. Stewart, J. Brown, J., Hagel, F. McFarlan, R. Nolan, P. Strassmann, and N. Carr, Does IT matter? An HBR Debate, Letters to the Editor, *Harvard Business Review*, Web exclusive, June, pp. 2–4. See http://harvardbusinessonline.hbsp.harvard.edu/b02/en/files/misc/Web_Letters.pdf

Carr, N., 2003, IT doesn't matter, *Harvard Business Review,* 81(5): 41

CEPI, 2000, *European Paper Industry to Create Common E-commerce IT Standards,* The Confederation of European Paper Industries, Brussels, Belgium. See http://www.cepi.org/htdocs/prelease/prelease_0015.html (Last accessed December 2002).

Chan, S., and Davis, T., 2000, Partnering on extranets for strategic advantage, *Information Systems Management,* 17(1): 58.

Cody, H.M., 2000, E-commerce dot-com companies target pulp and paper industry transactions, *Pulp & Paper*, 74(2): 32–41.

Cubine, M., and Smith, K., 2001, Lack of communication standards builds barriers to paper e-commerce, *Pulp and Paper,* 75(2): 32–35. See http://www.paperloop.com/db_area/archive/p_p_mag/2001/0002/barrier.htm

Dallmeyer, M.E., 2003, Interactive synergy, *Flexo Magazine Online*, February. See http://www.flexography.org/flexo/article.cfm?ID=54

Dupuy, C., and Vlosky, R., 2000, *Electronic Data Interchange and Buyer-Supplier Relationships,* Working Paper #40, 5 January, Louisiana Forest Products Laboratory, Louisiana State University Agricultural Center, Baton Rouge, LA, USA.

Fazio, T., 2000, The role of e-business in the pulp and paper industry, *Tappi Journal,* 83(8): 39–41.

ForestExpress, 2001, *ForestExpress Chosen by Forbes Magazine as Best of the Web*, Press Release, 17 September. See http://www.forestexpress.com/press/091701.jsp (Last accessed February 2003).

Friedman, S., 2000, *Good E-Views, Package Printing* (Philadelphia, PA, USA), 47(11): 45.

Hayhurst, D., 2001, Paper companies crawl into 21st century, *Pulp and Paper Industry*, 43(2): 11–13.

Juslin, H., and Hansen, E., 2002, *Strategic Marketing in the Global Forest Industries,* Authors Academic Press, Corvallis, OR, USA.

Kallioranta, S.M., 2003, *Role of eIntermediaries in the United States Paper Supply Chain*, Master's Thesis, directed by Professor Richard P. Vlosky.

Klass, C., 1999, Changes in retailing, print technology will force focus on customer needs, *Pulp & Paper* (San Francisco, CA, USA), 73(11): 71.

Lin, F., Huang, S., and Lin, S., 2002, Effects of information sharing on supply chain performance in electronic commerce, *IEEE Transactions on Engineering Management* (New York, USA), 49(3): 258.

Ling, R. and Yen, D., 2001, Extranet: A new wave of Internet, *S.A.M. Advanced Management Journal*, 66(2): 39.

McCune, J., 1998, The ins and outs of extranets, *Management Review,* 87(7): 23.

Meadows, D., 2004, EPC and RFID to revolutionize corrugated packaging, *Solutions! Tappi and PIMA*, 87(11): 27.

Moore, G., 2002, E-paper industry needs an online embrace, *PPI* (San Francisco, CA, USA), 44(9): 50.

papiNet, 2003. See www.papinet.org (Last accessed February 2003).

Patterson, J., 2004, *Radio Frequency Identification Adoption Will Surge In 2004, According To Packaging Strategies/Cap Gemini Ernst & Young Survey,* Cap Gemini Ernst & Young Press Release, 25 March. See http://www.us.capgemini.com/news/current_news.asp?ID=374 (Last accessed November 2004).

Pike, R.L., 2003, Letters to the editor, in T. Stewart, J. Brown, J., Hagel, F. McFarlan, R. Nolan, P. Strassmann, and N. Carr, Does IT matter? An HBR Debate, Letters to the Editor, *Harvard Business Review*, Web exclusive, June, p. 13. See http://harvardbusinessonline.hbsp.harvard.edu/b02/en/files/misc/Web_Letters.pdf

Porter, M., 1985, *Competitive Advantage,* The Free Press, New York, USA, pp.11–15.

Pponline.com, 2000, Panelists: Paper companies can't ignore potential of e-business. *Pulp and Paper Online*, 12 June. See http://www.pulpandpaperonline. com/content/misc/about.asp (Last accessed December 2002).

Pulp and Paper North American Fact Book (1998–1999), 1998, Miller Freeman. San Francisco, CA, USA. See www.eia.doe.gov/emeu/mecs/iab/forest_products /page6.html (Last accessed February 2003).

Saar, S., and Thomas, V., 2003, Toward trash that thinks, *Journal of Industrial Ecology*, 6(2): 133–146.

Shook, S., Vlosky, R., and Kallioranta, S.M., 2003, Why did forest dot.coms fail? Research Paper, *Forest Products Journal,* 54(10): 35–40

Stewart, T., Brown, J., Hagel, J. McFarlan, F., Nolan, R. Strassmann, P. and Carr, N., 2003, Does IT Matter? An HBR Debate, Letters to the Editor, *Harvard Business Review*, Web exclusive, June, pp. 1–17. See http://harvardbusinessonline.hbsp.harvard.edu/b02/en/files/misc/Web_Letters.pdf

Stora Enso, 2004, *Stora Enso and Stockway to Develop RFID-Based Smart Packaging Solution,* Stora Enso Press Release, 18 May. See http://www.storaenso.com /CDAvgn/main/0,,1_-5531-12183-en~pack,00.html (Last accessed November 2004).

Strassmann, P.A., 2003, Letters to the editor, in T. Stewart, J. Brown, J., Hagel, F. McFarlan, R. Nolan, P. Strassmann, and N. Carr, Does IT matter? An HBR Debate, Letters to the Editor, *Harvard Business Review*, Web exclusive, June, pp.7–9. See http://harvardbusinessonline.hbsp.harvard.edu/b02/en/files/misc/Web_Letters.pdf

Stundza, T., 1999, E-commerce is expanding—slowly, mostly in chemicals, *Purchasing* 127(6): 14–22.

Tan, G., Shaw, M., and Fulkerson, B., 2000, Web-based supply chain management, *Information Systems Frontiers* (Boston, MA, USA), 2(1): 41

Toland, J., 2003, King customer leads slow drive to e-business, *PPI* (San Francisco, CA, USA), 45(2): 28.

Varadarajan, R., and Yadav, M., 2002, Marketing strategy and the Internet: An organizing framework, *Journal of the Academy of Marketing Science*, 30(4): 296–312.

Vlosky, R., 2000, *E-Business in the Pulp and Paper Industry: A Comparison of the United States and Canada,* Working Paper #42, Louisiana Forest Products Laboratory, Louisiana State University, Baton Rouge, LA, USA.

Vlosky, R., Fontenot, R., and Blalock, L., 2000, Extranets: Impacts on business practices and relationships, *The Journal of Business & Industrial Marketing* (Santa Barbara, CA, USA), 15(6): 438.

Vlosky, P., and Punches, J., 1999, For forest products industry, now is the time for e-business, *Wood Technology* (San Francisco, CA, USA), 127(1): 48–50.

Yam, K.L., 2000, Intelligent packaging for the future smart kitchen, *Packaging Technology and Science*, 13: 83–85.

In: Hetemaki, Lauri and Nilsson, Sten (eds.). Information Technolgy and the forest sector. InternationalUnion of Forest Reseearch Organizations (IUFRO). Vienna, Austria, IUFRO World series 18: 105-128.