

**"Electronic Data Interchange (EDI): Implementation Strategies in the
Forest Products Industries"**

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Abstract

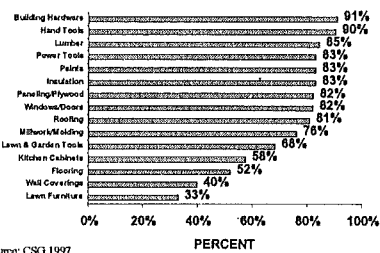
In recent years, the \$103 billion U.S. home center retail industry (in 1997) has modified their interactions with all vendors, including those that supply wood products, by instituting electronic commerce (EC) technologies. These retailers are increasingly adopting supply chain management (SCM) to electronically link various firms in their supply chain in order to better synchronize supply and demand. The use of labels attached to each piece of lumber, plywood, and other forest products containing a universal product code (UPC) bar code to use with point-of-sale scanning devices represents a necessary requirement to serve an expanding home center customer base. Homecenter retail customers, primarily the do-it-yourself (DIY) homeowner and the professional contractor/remodeler (PRO) are demanding shorter delivery times and lower costs. Global competition is encouraging electronic commerce (EC) solutions that facilitate SCM include bar coding, EDI, quick response (QR), just-in-time (JIT) and POS data gathering techniques. One Inter-Organizational Systems (IOS) technology of increasing importance to home center retailers is electronic data interchange (EDI). This paper reports the results of a study which examined EDI adoption in the wood products supplier-home center buyer channel.

Introduction

The North American wood products industry produces a diverse range of products sold through a myriad of distribution channels to a variety of customer segments. The U.S. homecenter industry is an increasingly important customer segment, with 1997

sales estimated at \$107 billion (CSG 1997). In 1996, 85 percent of the Top 500 homecenters in the U.S. stocked lumber and millwork products (Figure 1). In 1990, lumber products accounted for over 30 percent of total homecenter industry sales and contributed \$599/ft² of sales area, the highest for any merchandise category in the homecenter industry (CSG 1991). Moreover, more square footage is often dedicated to wood products than other products groups, thus underscoring the strategic importance for POS scanning homecenters to have UPC barcode labels on wood products.

Figure 1: Percent of Top 500 Home Centers That Carry Each Product



Source: CSG 1997

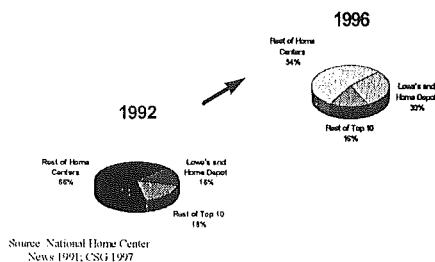
In 1992, only 37 percent and 16 percent of the Top 500 U.S. homecenter respondents POS scanned in general and scanned wood products, respectively. These POS scanning homecenters accounted for 36 percent of total industry sales that year. Those that POS scanned wood products represented 30 percent of industry sales. However, of the Top 50 homecenter retailers, 75 percent had POS capabilities in 1991 (National Home Center News 1992).

On the supplier side in 1992, UPC barcoding by U.S. wood products suppliers for homecenter retail customers was limited to a relatively

small percentage of study respondents. However, these barcoding respondents represented a significant portion of North American production in many wood products groups: 38 percent of treated lumber production; 27 percent of OSB; 24 percent of softwood plywood; and 22 percent of softwood lumber (Forest Industries 1992/3).

These numbers provide insight into early IOS information technology adoption in these industries: (1) that the early adoption occurred in the early 1990's; and (2) that early adoption occurred among the larger buyers and suppliers within this dyad. U.S. homecenter industry consolidation increases the importance of electronic commerce capabilities for wood products suppliers. From 1992 to 1996, the top 10 homecenter retailers' share of industry sales increased from 34 percent to 46 percent. The two largest homecenters, Home Depot and Lowe's, increased their market share from 16 percent to 30 percent during this four-year period (CSG 1997) (Figure 2).

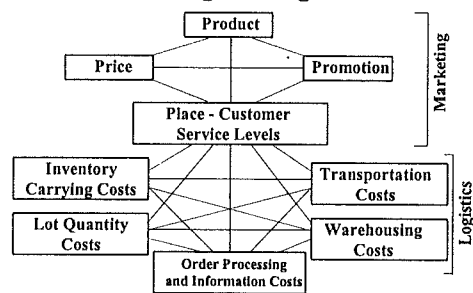
Figure 2: Industry Consolidation Accelerates



Leading edge homecenter retailers are striving to deliver low-cost, high quality, highly customized products efficiently with seamless exchange transactions. This requires effective

integration and coordination of intra and inter organizational distribution systems through information-driven supply chain management (SCM). These business logistics systems represent a significant cost to homecenter retailers and provide an opportunity for gaining and sustaining competitive advantage. Excellence in logistics is the only element of the 4-P's that cannot be easily matched by competitors (Figure 3) (Emmelhainz 1996). For instance, Home Depot is able to offer everyday low prices because it has developed an integrated, information-based distribution and supply system with most of its vendors.

Figure 3: Marketing and Logistics



IOS Information Technology

IOS's are based on information technology that crosses organizational boundaries (Bakos 1991). Johnson and Vitale (1988) define IOS as: "... *an automated information system shared by two or more companies and built around computer and communication technology that facilitates creation, storage, transmission and transformation of information. An IOS differs from an internal distributed information system by allowing information to be sent across organizational boundaries.*"

IOS technology impacts inter- and intra-firm management and business practices that, in turn, influence such areas as economic value creation and strategic competitive advantage. According to Johnson and Vitale (1988), most successful IOS users have recognized that increased familiarity with customers, dealers or suppliers afforded by joint systems leads to collaborative behaviors that improve economic performance by both partners.

IOS technologies for the wood products industry includes the integration of Universal Product Code (UPC) barcodes with the use of Electronic Data Interchange (EDI) to improve communication between buyers and sellers (Emmelhainz 1993). These channel strategies for enhancing competitiveness by improving speed, quality and accuracy are often referred to in the retail industry as Just-In-Time (JIT) manufacturing - based on the idea that, whenever possible, no activity should take place in a system until there is a demand for it. Quick Response (QR) is an product of JIT logistics in that the development of quick systems is necessary if one is successfully implement time-based systems (Topken 1996). EDI and bar coding allow business to cut time from the supply chain and be more responsive to retail customers' needs.

IOS information technology has changed the way homecenter retailers conduct business. IOS allows wood products suppliers to exchange documents such as purchase orders and invoices with, and make payments to, their homecenter retail customers. IOS allows a company's logistics processes to be synchronized their business partners accurately, efficiently, and

seamlessly (Topken 1996). U.S. homecenter retailers are improving their supply chain management (SCM) to reduce costs, improve inventory performance, increase customer direct shipping from manufacturing sites, establish closer relationships with their vendors and improve their computer support systems.

POS UPC Barcode Scanning

Bar code based inventory management and control is an accurate and cost effective method of automating the identification and management of shipping units whereas the barcoded tags are attached to units of lumber, plywood and other wood products (Vlosky 1994). Information contained on the unit level bar coded products may be used for internal inventory management or be communicated to customers as part of a joint inventory strategy. This is an important distinction from a different bar code symbol, the Universal Product Code (UPC), which is used on individual boards, panels or other products destined for retail point-of-sale (POS) scanning customers.

For U.S. homecenters, the volume of customer and sales information (obtained through POS scanning of UPC bar coded products) on purchase items, volume, date and time of sale, store, tie-in sales (other items purchased at the same time by each customer), etc., has make retailing more of a science (Andrews 1992). Vlosky and Smith (1993) reported that retailers implement UPC barcode POS scanning for a number of reasons, all of which are intended to increase efficiency, profitability, and competitiveness. They cite primary benefits of POS scanning as: (1) a reduction in errors; (2)

checkout line throughput improvement; (3) improved inventory performance; (4) enhanced buyer-supplier communications; and (5) improved data for consumer market research.

Homecenter suppliers have been encouraged to UPC barcode their products or face the prospect of being replaced by UPC-capable competitors. Supplier benefits of implementing UPC barcoding include: (1) product differentiation (product descriptions and corporate logo's can be placed on a barcode label); and (2) development of stable business relationships resulting from direct links between company information systems.

Figure 4 illustrates the ever-increasing demands customers are placing on their vendors. Basic, industry-wide requirements such as UPC barcoding at the unit and piece level, reduced lead times, strict delivery schedules and specialized packaging make EDI systems increasingly valuable. Additional IOS information technology requirements loom for suppliers - that is, the ability to obtain, exchange and process information quickly and accurately and the need to provide smaller and more frequent shipments (Emmelhainz 1996).

Figure 4:
Demanding Customers

Home Center Industry:

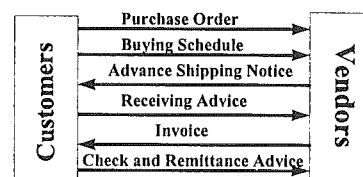
- Basic Service Requirements
 - On-time delivery with strict appointment schedule
 - Short lead times (< 10 days)
 - Bar coding - packing and units
- Customer Service Requirements
 - Customized case packs
 - Special placement of bar codes
 - Store ready packaging
- Emerging requirements
 - Data integrity and accuracy
 - Shipping container marking
 - Advance Ship Notice (ASN)

Source: Emmelhainz 1996

Electronic Data Interchange (EDI)

This paper examines one IOS information technology, EDI, in the homecenter buyer-wood products supplier channel. EDI is arguably the most critical component of SCM. It can link customers, channel intermediaries and manufacturers to expedite product flow as well as connecting internal departments within organizations (Lavery 1996). EDI is defined as "the electronic transmission of business documents in a standard format which is both computer readable and computer processable." EDI is not e-mail or fax transmissions. A typical EDI transaction may include electronic transmission of purchase order, customer buying schedule, advanced shipping notice (ASN), invoice and electronic funds transfer of payment (EFT) (Figure 5). EDI benefits include reduced paperwork, costs of paper processing and filing, data entry costs, purchasing lead times, errors, required inventory levels, postal charges and unproductive phone calls.

Figure 5:
Typical EDI Business Transactions



Source: Smith and Vlosky 1994

Objectives

This paper reports results from a study conducted in 1992/3 to profile the implementation of UPC barcoding between wood products suppliers and

homecenter retailer customers in the United States.

Methods

On the buyer side, the study samples consisted of the 500 largest (by sales) home center retail companies in the United States. The 1992 National Home Center News Annual Retail Scoreboard (1992) was used to identify and select sample frame members and the Directory of Home Center Operators and Hardware Chains (1991) was used to identify key informants. On the supplier side, the study sample consisted of the 447 largest (by sales revenue for distribution intermediaries and by volume for manufacturers) wood products companies in North America taken from seven supplier populations (manufacturers of six major product groups plus distributors).

As was the case for home center retailers, a purposive (judgement) sample design was determined to be the most appropriate due to the studied opinion that larger, more influential home centers are most relevant as early adopters of IOS technologies (Vlosky and Smith 1993; Widman Management 1990). In the homecenter industry, the sample of top 500 firms represented 67 percent of the \$67 billion of sales in 1992 (\$103 billion in 1997) (CSG 1991; CSG 1997).

Mail surveys followed methods and procedures recommended by Dillman (1978) including pretesting,

pre-survey notification of the initial mailing, a post-survey reminder and two additional survey mailings. Of the 500 homecenter firms, 173 usable surveys were completed resulting in an adjusted response rate of 36 percent. For the wood products suppliers, 154 usable surveys were returned from an adjusted sample of 447 firms resulting in an adjusted response rate of 34 percent.

Results

Profile of respondents - buyers.

The 1992 average sales for the 173 homecenter retail respondents was \$132 million and represented \$22.9 billion mn total sales or 34 percent of the entire homecenter industry (National Home Center News 1993). Table 1 summarizes homecenter profiles for total, EDI capable and EDI partner with wood product supplier respondents.

As shown in Table 2, 18 homecenter respondents had 1992 sales of \$100 million or more and accounted for 82 percent (\$18.8 billion) of total 1992 respondent sales. These figures are consistent with data for the top 500 U.S. homecenters, illustrating the importance of large multi-store companies in this retail sector.

EDI capable homecenters are also characterized as large firms with 1992 sales averaging \$504 million versus \$38 million for non-adopters. Finally, 77 percent of the revenue of the 173 homecenter respondents used EDI in 1992.

Table 1. Homecenter respondent profiles for total, EDI capable and EDI partners with wood product suppliers.

	Total respondents	Respondents EDI capable in 1992	Respondents with wood product supplier EDI partnerships in 1992
Sample size	173	35	6
1992 sales (\$ billion)	\$22.9	\$17.6	\$15.3
Percent of 1992 homecenter industry total sales	34%	26%	23%

Table 2. Profile of homecenter respondents relative to the Top 500 homecenters: Sales above and below \$100 million in 1992.

	Number of companies (total)	Average number of stores per company	Average company 1992 revenue (\$ million)	Total sales revenue (\$ billion)	Percent of total revenue (respondent) or top 500
<i>Sales of \$100 million or more:</i>					
Respondents	18	87	\$1,044	\$18.8	82%
Top 500	49	73	\$680	\$33.3	73%
<i>Sales less than \$100 million:</i>					
Respondents	156	5	\$26	\$4.1	18%
Top 500	451	5	\$26	\$11.7	26%

Profile of respondents - suppliers. The 154 responding wood products manufacturers/distributors represented an average of 35 percent of total North American production in 1992. As was the case with homecenter retailers, large wood products firms lead in implementing EDI to serve the homecenter customer. These findings are consistent with results of a study of EDI implementation in a wide range of industries which found EDI user firms

tend to be large corporations (Banarjee and Golhar 1994).

Barcode Based Inventory Management

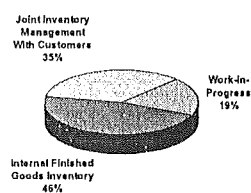
Barcode based inventory management is an accurate and cost effective method of automating the identification and management of shipping units. Information contained on unit level bar coded products may be used for internal inventory management and control or be communicated to

customers as part of a joint-inventory management strategy.

Study results indicate that most wood product supplier respondents that have bar code based inventory systems use them for internal purposes, either work in progress (19.2%) or finished goods inventory management (46.2%) (Figure 6). However, 34.6% stated that they use this information to support joint inventory management with customers. However, inventory information continues to be conveyed verbally over the telephone rather than electronically using EDI. The reasons given by wood products respondents for implementing bar code based inventory management capabilities are as follows (ranked in order of importance): (1) real-time inventory management; (2) cut order response time; (3) improve efficiency and productivity; (4) reduce physical inventories; (5) greater speed and accuracy; and (6) improve customer service.

Figure 6:

**Bar Code Based Inventory Management:
Wood Products Suppliers**



For homecenter retail buyers, the major reasons, in ranked order, for implementing barcode based inventory management are: (1) improve inventory control and management; (2) reduce data entry errors; (3) speed up product

replenishment; (4) reduce costs; and (5) increase market share.

EDI Implementation Strategies for Homecenter Retail Buyers

Of the 173 responding homecenters, 35 (20 percent) were EDI capable in 1992 (at the time of the study) and an additional 43 (25 percent) planned to implement EDI by 1995. However, only 12 responding homecenters were either involved in EDI or planning to be so by 1995 with their wood product suppliers. However, revenue represented by these 12 homecenters accounted for 70 percent of total respondent revenue in 1992 or 23 percent of total 1992 sales for the entire homecenter industry. As previously stated, from 1992 to 1996, the top 10 homecenter retailers' share of industry sales increased from 34 percent to 46 percent (CSG 1997). This suggests that implementation of EDI with wood products vendors was at a very early state in 1992 and that the leaders are the larger firms that have subsequently increased their dominance of the homecenter industry. Although homecenter EDI lead adopters are characterized as large companies, the 1992 study data suggest that early adopters also include midsize and small companies (Figure 7).

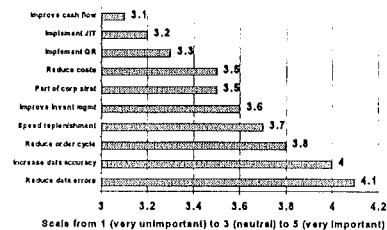
Figure 7:
EDI Adopters vs. Non-Adopters By Firm Size
Home Center Buyers & WP Suppliers (1992)

SECTOR:	Company Size	
	Adopters (MEAN)	Non-Adopters (MEAN)
Home Centers Revenue (\$ million)	\$504 (n=35)	\$38 (n=138)
Softwood Lumber Prod'n. (MMBF)	918 (n=7)	307 (n=23)
Treated Lumber Prod'n. (MMBF)	85 (n=7)	49 (n=12)
Softwood Plywood Prod'n. (MMSF 3/8")	2,066 (n=3)	228 (n=16)
OSB Prod'n. (MMSF 3/4")	617 (n=3)	214 (n=4)
Particleboard Prod'n. (MMSF 3/4")	514 (n=4)	54 (n=8)
MDF Prod'n. (MMSF 3/4")	102 (n=3)	56 (n=2)
Distribution Intermediaries Revenue (\$ million)	\$410 (n=15)	\$115 (n=45)

The costs to implement EDI among homecenters are relatively low. Eighty-three percent of EDI capable respondents developed EDI capabilities for under \$1 million. However, two respondents spent over \$10 million to implement EDI. Figure 8 ranks the reasons or expected benefits that homecenter retailers hope to gain from implementing EDI. All 10 attributes have mean scores above neutral (3.0), however, error reduction and inventory control and management issues are at the top of the chart.

Although the small sample sizes and exploratory nature of the study, generally preclude higher order statistical analysis, a maximum likelihood factor analysis was conducted to show the underlying relationships of the 10 attributes in Figure 8ⁱ. Four distinct factors were identified and labeled using the highest loading variable as the factor surrogate. These 4 factors represented 82 percent of the variance in the 10 attributes.

Figure 8:
Home Center Reasons to Implement EDI



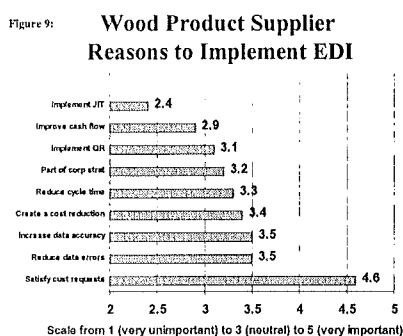
Qualitatively, the four factors can be summarized for managerial implications as follows:

- **Order cycle improvement** - the ability to improve inventory management and control, channel cycle time and product replenishment through increases in internal efficiencies.
- **Error reduction** - reduced errors and increased accuracy which are directly correlated to cost reductions.
- **Corporate strategy** - the commitment by management that EDI adoption transcends all corporate function areas and will result in improved cash flow.
- **Higher order inventory management** - EDI as a component of quick response and just-in-time inventory should be examined.

EDI Implementation Strategies for Wood Products Suppliers

ⁱ The factor analysis is presented in more detail in Vlosky, Smith and Wilson 1994.

In 1992, 42 suppliers (27 percent of respondents) conducted EDI and an additional 48 companies (31 percent) were planning implementation between 1992-1995. The primary reason EDI was being adopted by wood product suppliers by 1992 was in response to homecenter customer requests. Additional perceived benefits included a reduction in data errors, increased data accuracy and cost reductions (Figure 9).



As with homecenter retailer responses, a factor analysis (principal components) was conducted in spite of the limitations inherent in small sample sizes. Again, four underlying factors were identified and labeled according to the highest loading of the surrogate variable. These four factors represented 84 percent of the variance of the 9 criteria items. These four managerial groups are:

- **Cost reduction as part of an overall corporate strategy** - especially when part of a quick response and just-in-time inventory management strategy.
- **Reduced cycle time** - as it directly correlates to

improved product and order cycle time, error reduction and improved accuracy.

- **Satisfy customer needs** - the primary motivator for wood products suppliers in this study to continue being (or become) a reliable vendor.
- **Cash flow considerations** - EDI affects all corporate functions and in turn, influences cash flow timing and levels throughout a corporation.

Managerial Implications

Additional questions were posed to respondents on both sides of the buyer-supplier dyad that shed insight on the requirements for successful EDI implementation.

Number of exchange partners to warrant EDI implementation - Supplier respondents initially implemented EDI to satisfy the needs of only one or two key home center customers. Conversely, all major EDI capable homecenters indicated that EDI was a critical part of their corporate strategy and that development of EDI partnerships with suppliers was highly desirable, if not an existing or impending requirement. Homecenter buyers are clearly the driving force behind EDI implementation. In 1992, EDI partnerships with wood products suppliers lagged other homecenter retail merchandise categories; however, given the importance of wood products to this retail sector, the number of EDI-capable wood product suppliers must increase.

Customer needs identification -

On the supplier side, the marketing and sales function was found to be the primary influence in initiating EDI partnerships with customers. These customer IOS information technology needs are sometimes coordinated with the management information systems (MIS) function. On the buyer side, merchandisers and buyers typically work closely with personnel from MIS as well as a designated EDI coordinator.

Project development and maintenance - After the supplier's marketing and sales functions identify customer EDI requirements, the MIS function is responsible for establishing and maintaining the EDI linkage.

Buyers also shift much of the responsibility for EDI implementation and maintenance to MIS, although a closer coordination with merchandising and the EDI coordinator continues.

Linkage facilitators - An importance source of information about EDI are technology product and service providers. Although EDI can be accomplished directly between trading partners, the transmission of business documents is typically done through the use of intermediaries called value-added networks (VAN's). VAN's serve as cost-effective communications links between trading partners, offering the ability for a single entity to communicate efficiently with numerous other parties in a single transaction. By providing both buyers and suppliers with "electronic mailboxes," VAN's can promote efficiencies by eliminating communications with each trading partner individually and the ability to pick up electronic transmissions on demand without time consuming scheduling (Cesario 1991).

Summary

EDI implementation in the wood products industry is in the early adoption stages. The integration of UPC bar coding and EDI into quick response and just-in-time electronic technology management has barely started in this industry with only a few large wood products suppliers and homecenter buyers showing any degree of involvement. Mike Blackwell, Director of Transportation and Logistics for Building Products at Georgia-Pacific, described supply chain management (SCM) at his company in an article in Distribution Magazine as follows (In Lavery 1996):

Georgia-Pacific (G-P) is the largest building products distributor in the U.S. Prior to centralization, each business unit at this company had its own transportation and logistics structure with little coordination among managers. There was minimal coordination and information sharing. Individual departments had little incentive to act outside their own areas, and there was no motivation to consider the interests of other business units or the needs of the company as a whole. The result was an intense internal rivalry for transportation resources, accompanied by considerable dissatisfaction and frustration among carriers trying to please many customers within the company.

To solve these challenges, G-P reorganized internally,

establishing a new transportation and logistics division that serves all G-P business units. The company uses EDI technology for logistics management. EDI pick-up orders are sent to carriers who send acceptances, rejections, or counter-proposals within minutes. The company is currently working to integrate sales department information and customer data into the system for wider-ranging SCM solutions.

POS scanning data gathering uses bar code labels to acquire information at the check-out counter, then allows this information to be transferred via EDI directly to the manufacturer's order entry system. This fundamental system of UPC bar coding and EDI allows data sharing throughout the entire supply chain - from the forests, through the primary, secondary and tertiary manufacturing processes, through the channels of distribution, to the end-use customer. This provides a powerful competitive tool in today's global marketplace in the drive to do more with less; to reduce inventories and costs and shorten order cycle times; and to deliver the right product to the right customer at the right time. The wood products suppliers with the vision and cohesive program to develop efficient channel structures and partnerships with customers will strengthen their competitive position. Those who do not change will be left behind.

According to Ohio State University Professor Bernard LaLonde, ... Logistics functions that survive in the

21st century will focus on supply chain relationships that improve competitive performance and reduce asset investments."

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