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Capacity, Production, and Manufacture of Wood-Based Panels in North America

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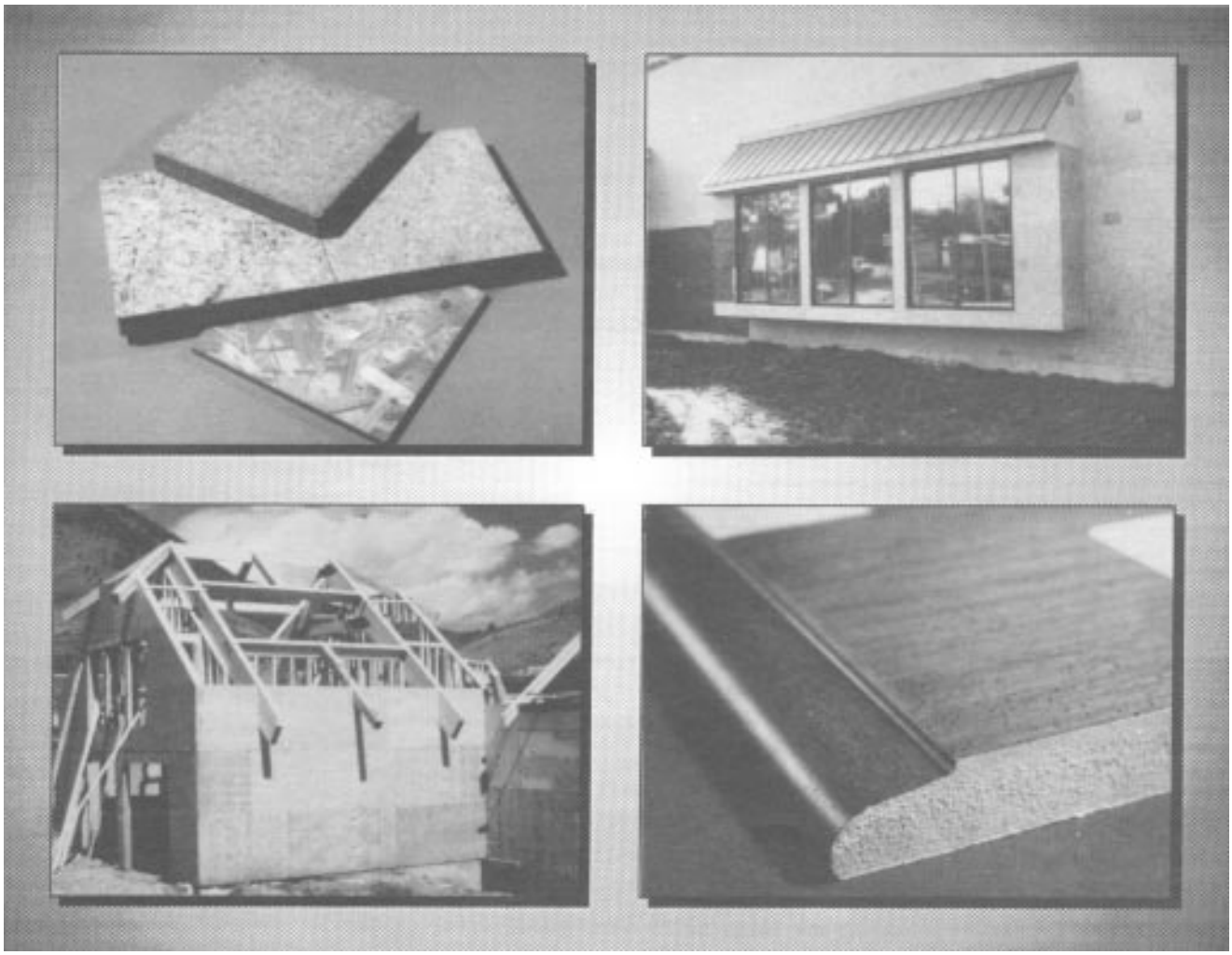

Abstract

This report is an informational report about four wood-based panel industries: particleboard, oriented strandboard, medium density fiberboard, and Southern Pine plywood. Items highlighted are trends in manufacturing and new plant costs, industry manufacturing capacity, and location. Recent data show the greatest amount of growth taking place in the oriented strandboard sector. Modest rates of growth are occurring in the Southern Pine plywood, particleboard, and medium density fiberboard sectors.

Keywords: Particleboard, oriented strandboard, plywood, capacity, cost, prices

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Capacity, Production, and Manufacturing of Wood-Based Panels in North America

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Introduction

This is a report about the North American engineered wood-based panel industry. The purpose is to provide a reference to the location and size of plants, average manufacturing costs, and trends in the costs of building new capacity. Specifically, the report traces the development of the particleboard, oriented strandboard (OSB), medium density fiberboard (MDF), and Southern Pine plywood industries.

Since World War II, few areas in forest products have afforded more economic opportunities than the wood-based panel industry. The sometimes rapid growth attests to the potential offered by new technologies. This growth is also evidence of changes in North American forest products utilization, from a condition based on an abundance of high-quality, low-cost timber in the Pacific Northwest to one where increasing scarcity of such material has forced an adaptation to lower quality resources in the South and North.

This report provides a perspective on the manufacturing conditions in the wood-based panel industry, focusing on capacity, cost of new plants, manufacturing costs, and prices. The nature of the markets for these products is cyclical, a condition that is sometimes exacerbated by producers' overly optimistic investment responses in good economic times and by caution in bad times. The report begins by describing capacity and production trends in the four industries: particleboard, OSB, MDF, and Southern Pine plywood. This is followed by an analysis of capacity costs. The report concludes with historical trends of manufacturing costs and prices in each industry.

Background

Particleboard was the first of these four industries to develop. Its beginnings can be traced to 1947 in Seymour, Indiana, where a particleboard plant was built based upon modern standards.

Particleboard can be manufactured by extrusion pressing or by flat, mat-formed pressing. This report deals only with the flat-pressed segment, because it represents the bulk of the industry. In flat pressing, wood particles are blended with wax and urea-formaldehyde resin and then compressed in heated presses where the resin cures and solidifies the particles into panels.

The presses are either batch (single or multi-opening) or continuous. Continuous presses cost more initially but can yield processing economies. These presses have become widely adopted in Europe and elsewhere. However, most plants in North America continue to employ traditional multi-opening presses because these panels are made dense and thick, which slows down the throughput of continuous presses. It is also claimed that frequent product changeovers hinder continuous press productivity (Donnell 1991).

In most cases, the wood supply used in particleboard plants consists of residues from sawmills or other wood processing plants. A few North American plants, however, use roundwood as furnish. In recent times, wood residues have become scarce in the western United States, and several plants have experimented with alternative fibers, such as wood demolition debris and nonwood based fibers (e.g., straw) to augment fiber supplies.

An engineered wood-based panel that has many similarities to particleboard is OSB. This product is made exclusively from roundwood because of the need to control the geometry of the wood particles, which affects board properties. The particles are typically slender, thin strands that are aligned to increase strength in desired directions of the panel. Oriented strandboard is manufactured using exterior-type waterproof, boilproof phenol-formaldehyde and isocyanate resin binders. When isocyanate is used, it is typically put only in the cores of the panels. Although the process appears similar to particleboard, OSB mat forming is more complex to ensure alignment, and press pressures and temperatures are increased.

Medium density fiberboard is another engineered wood-based panel product. The main difference from the particleboard process is that the particles used in MDF are further broken down or refined. In North America, the predominant source of wood for MDF is also sawmill residues, but some plants (e.g., in New Zealand) use roundwood for better control of fiber size, thus the physical properties of the board. Another difference in the process is the ability to use woods with a wider range of density. By reducing wood to individual fibers or bundles of fibers, the importance of the initial wood density is diminished because the density of cellulose fibers is more uniform across species. Continuous pressing technology has been more widely adopted in MDF than in particleboard. The first North American MDF plant was built in 1965 in Deposit, New York. Since then, MDF production has grown steadily as end users became familiar with its superior machining qualities.

The first Southern Pine plywood plant came on line in 1964 as problems associated with processing a smaller, more resinous wood species were solved. Southern Pine plants were built at a rapid pace to take advantage of a less expensive timber resource than western Douglas-fir. With the advent of OSB, some observers expected plywood technology to become obsolete. Although many plywood plants in the West closed and few softwood plants have been built since 1982 in the United States, the Southern Pine plywood industry has continued to expand by modernizing and updating existing mills.

Plant Capacity and Production Trends

Figures 1–4 show the historical trends in capacity and production for the four panel industries. Appendix Tables 2–6 give the location and capacity of individual plants.

One main trend has been the decreasing share of capacity located in the western United States (Fig. 5). About 30 years ago, more than 50 percent of all nonplywood board capacity was located in that region. In contrast, the capacity share is currently about 20 percent.

Another notable trend is the increasing capacity of the average plant. Those built to a smaller scale in the early period of the industry have, for the most part, been retired or overhauled to bring them up to current economic standards. The average panel plant's capacity was about 60 million ft^2 (3/8-in. basis) in the 1960s (see Table 1 for metric conversions).[1] By the 1970s, this capacity almost doubled. Currently, the industry averages around 200 million ft^2 per operating plant, while new plants, mostly OSB, average about 350 million ft^2 per operating plant. Capacities of MDF plants tend to be somewhat smaller, and the current average is around 160 million ft^2 per plant (Fig. 6).

One consequence of increasing plant size is a larger wood procurement radius. Increased size offers economies of scale within the plant, but causes diseconomies in procurement because the wood has to be brought from a wider area. The procurement radius is unique to each location, but the following equation offers a general rule of thumb:

$$\text{Procurement radius (miles)} = 10 + 3.9 \times \text{square root of plant capacity (3/8-in. basis)}$$

Figure 7 shows this relationship using 13 OSB mills from which data were obtained. The effect of plant size on wood hauling costs can be estimated from the equation. For a 160 million ft^2 plant, the equation indicates a 59 mile radius. Based upon an average haul of 42 miles, assuming a US$0.12 per ton-mile haul cost and US$2 per ton turnaround cost, this mill faces an average hauling cost of US$7.0 per green ton or approximately US$14.1 per dried ton, which translates to US$9.9 per thousand ft^2 (3/8-in. basis). In contrast, a 450 million ft^2 mill would have a procurement radius of 93 miles.

Table 1—SI conversion factors

English unit	Conversion factor	SI unit
cord	3.62	cubic meter (m^3) of stacked wood
foot (ft)	0.3048	meter (m)
square foot (ft^2)	0.09290	square meter (m^2)
gallon (U.S. liquid)	0.004	cubic meter (m^3)
inch (in.)	25.4	millimeter (mm)
mile (international)	1.609	kilometer (km)
pound (lb)	0.45	kilometer (km)
ton	907.2	kilogram (kg)

[1]Note that particleboard and MDF are generally measured on a 3/4-in. basis but have been converted to 3/8-in. in this report for consistency in comparison.

Assuming an average haul of 65 miles, this operation's hauling costs would be US$9.8 per green ton, US$19.6 per dried ton, and US$13.7 per thousand ft². The larger mill faces a penalty of US$3.8 per million ft² of product.[2]

There has been significant processing changes in manufacturing these products. In the case of OSB, faster press times have increased plant efficiency. This is evident from the growing spread between rated capacities and what can be inferred from actual press sizes. Figure 8 depicts the difference between announced and standard capacities calculated from each mill's individual press and from an arbitrarily chosen press cycle of 5.25 min (for 7/16-in. panels). This comparison shows that initial plant capacity in most cases was below the standard, indicating that press cycles, on the average, were more than 5.25 min long. For the past 30 or so mills that were built, rated capacities have generally exceeded the standard, indicating that cycle times are now less than 5.25 min. In fact, OSB press cycles are now around 3 min, including loading/unloading time of 45 s (Lowood 1994).

Another notable change in OSB manufacturing has been the decreased use rate of resins. Initial liquid resin use rates averaged 5 percent of the panel's weight in contrast to the current average of 3.2 percent. When powdered resins were employed, the use rate ranged from 3.0 to 3.5 percent, whereas now it is less than 2 percent (Davis 1993, Morley 1986).

Capacity Costs

Capacity costs in this report are based on plant announcements and offer only a rough guide to capacity cost trends. Costs of new mills have generally increased with inflation, although economies of scale obtained from larger complexes have moderated the increase on the basis of a thousand ft² of capacity.

Based on published mill announcements, a new MDF mill will cost approximately US$500 per thousand ft² (3/4-in. basis) of capacity, or US$50 million for a 100 million ft² complex. This is an increase from about US$200 per thousand ft² from the early 1970s.

New particleboard plants also cost significantly more than those placed in service in the 1970s (Fig. 9). Aside from inflation, this increase can be explained by the tendency of modern mills to be built with the capability of making laminated rather than only raw boards. One mill was recently built to run on roundwood instead of plant residues, adding to its equipment needs. Based on plant costs from the 1970s and subsequent capital goods inflation trends, I estimate that a raw board production facility comparable to those built in the 1970s would currently cost around US$400 per thousand ft² (3/4-in. basis) of annual capacity, or US$40 million for a 100 million ft² plant.

Unlike MDF and particleboard costs, OSB plant costs have defied inflation trends since 1980 (Fig. 10). This may be due to economies of scale as the plants currently being installed are about twice as large as those in the late 1970s. Recent plant announcements indicate that a new OSB mill costs approximately US$230 per thousand ft² (3/8-in. basis) of capacity or US$80 million for a mill with an annual capacity of 350 million ft².

A plywood mill has not been built in the South since 1982. However, based on capital goods inflation trends, the estimated cost for a new plywood mill would be about US$230 per thousand ft² (3/8-in. basis), which translates to about US$60 million for a 260 million ft² plant (Fig. 11).

Manufacturing Costs and Profits

The hallmark of most reconstituted panel mills is high volume output of a basically undifferentiated commodity. The primary elements of manufacturing costs for these operations are wood, resin, and labor.

Wood costs per ton are given for plywood, OSB, and particleboard in Figure 12. Historically, wood costs for plywood mills have been the highest because of larger, higher quality timber requirements. Over time, technology has enabled the economic use of smaller-sized logs, but the wood used for plywood is still more expensive than for OSB.

Data in Figure 12 are not comparable because the wood for particleboard is partly dried mill residues and that for plywood and OSB is green stumpwood. Figure 13 compares wood costs on the basis of the finished product, all adjusted to a common basis of product measurement and with the value of salable residues subtracted from plywood costs. Even after subtracting the value of such residues, wood costs per unit of output for plywood are the highest among the three processes, and under recent economic conditions, about twice that of an OSB operation. However, particleboard wood costs by product are less than for OSB.

In the realm of resin costs, plywood technology has traditionally maintained an advantage (Fig. 14). Although the amount of resin use in OSB processing has declined by more than 30 percent since the mid-1970s, it is still about twice as expensive as it is for plywood. Current levels of liquid phenol-formaldehyde use (on a dry basis) for OSB

[2]This relationship does not necessarily hold for other panels. Hauling costs would be affected by differences in bulk density, moisture content, and loading/unloading time.

commodity grade panels average a little more than 3 percent by weight (about 45 lb for a thousand ft², 3/8-in. basis) and a little less than 2 percent (about 28 lb) if the powdered form of the resin is used. For particleboard, the use rate of urea-formaldehyde resin is about 8 percent or 140 lb for a thousand ft², 3/8-in. basis. This threefold use rate offsets a price advantage that is about 70 percent, so the total cost per thousand ft² is approximately equal between OSB and particleboard. Medium density fiberboard costs are similar to those for particleboard.

Figure 15 shows trends in labor costs. Plywood mills have made great strides in automation, but the nature of the material and process requires an increase in labor for tasks such as loading dryers and presses, laying up panels, and joining strips of veneer to make standard-sized sheets. Meanwhile, economies of scale in OSB mills have reduced labor costs.

Estimates of overall variable production costs are contained in Tables 7 to 9 in the Appendix and are summarized in Figure 16. On a per ft², 3/8-in. basis, costs ranged in 1993 from about US$153 for plywood to US$102 for particleboard; OSB costs were intermediate at about US$113.

The ratio of variable production costs to market prices gives some indication of the relative profitability of these products.[3] This relationship is shown in Figure 17 for plywood and OSB. In the 1970s and early 1980s, the profitability of OSB was greater than that of plywood. As a result, OSB attracted the bulk of the investment in new capacity. New plywood mill construction waned and capacity increases that occurred were mainly due to modernizing and upgrading plants. Around the mid-1980s, the profit margin of OSB and plywood came closer and capacity growth in OSB slowed. Since 1991, profitability of both panels has increased but that of OSB has gained much more as a result of the better control of the previously described costs and the narrowing of the price discount for OSB compared with plywood. As a result, a new wave of investment has been attracted to OSB with more than 4 billion ft² of new capacity expected from 1994 to 1997.

Figure 18 gives the ratio of variable production costs to market prices for plywood and particleboard. Particleboard was highly profitable in the 1960s and early 1970s, during which capacity increased sevenfold. This profitable period ended with the 1974 to 1975 recession. Profits recovered by the late 1970s, but not to the previous degree, and capacity growth slackened.

[3]Costs for insurance, taxes, and capital are not included; therefore, these ratios are not a true guide to overall profitability. When compared with the older plywood industry, capital costs would be greater especially for OSB and particleboard plants.

Conclusions

During the past three decades, growth of reconstituted panel manufacturing has been rapid. High profitability attracted a great deal of investment interest in the early phase of the industries, but as they matured and profit rates declined to normal levels, growth rates tended to decrease. Currently, the OSB industry is in the rapid growth phase that plywood and particleboard had previously. At the time of this report, all segments of the panel industries are having favorable economic conditions, but OSB continues to have significantly lower costs than those panels with which it competes.

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Appendix—Wood-Based Panel Industry Data

Tables 2 to 6 give the location and capacity of individual plants for the four panel industries: OSB, particleboard, MDF, and Southern Pine plywood. Tables 7 to 9 contain estimates of overall variable production costs for OSB, particleboard, and Southern Pine plywood.

Table 2—OSB capacity—by year of construction

Plant	Region	Location	Company	Initial Capac.	Cost	Year Built	Capac. Cost	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
				MMSF	Mil. $		$/MSF											MMSF									
42	4	Hudson Bay	McM-Bloed	80		1964		80	80	80	80	80	80	80	90	90	90	90	90	90	90	90	90	90	90	90	90
77	4	Hudson Bay	McM-Bloed	110		1968		110	110	110	110	110	110	110	110	120	120	120	120	120	120	120	120	120	120	120	120
1	1	Gr.Rapids	Blandin	100	13	1972	130	130	140	140	140	40															
44	4	Timmins	Waferbd	70		1973		70	70	70	70	70	70	80	80	90	90	90	90	90	90	90	90	90	90	90	90
43	4	Longlac	Weldwood	110		1973		110	110	110	110	110	110	110	110	110	136	136	136	136	136	136	136	136	140	150	150
45	4	Thunder B	McM-Bloed	100	10	1974	100	110	120	120	120	120	120	120	130	160	160	170									
46	4	Thunder b	Gt.Lakes	125		1975		125	125	125	125	130	130	140	140	150	160	160	160	160	160	160	160	160	160	160	160
57	5	Slave Lk	Weyerhaes	110		1977		110	110	110	110	110	110	110	110	110	110	110	110	110	110			140	140	140	140
2	1	Hayward	L-P	130	25	1978	192		130	130	130	130	130	130	150	180	170	175	180	200	230	230	230	230	230	230	230
47	4	Chatham	Atl Wfbd	160		1979				160	160	160	160	160	160	180	180	200	200	220	220	50			110	220	220
49	4	LeSarre	Normick-P	80		1980					80	80	80	80	80	90	100	100	100	100	100	100	100	100	100	300	300
48	4	St.Georges	Malette	150		1980					150	150	150	150	150	150	160	160	160	160	160	160	160	160	160	160	160
3	1	Woodland	G-P	140		1981						100	140	140	140	140	155	155	155	155	155	155	155	155	155	155	155
1	1	Gr.Rapids	Blandin	250		1981						200	280	280	280	280	280	340	340	340							
7	1	Solway	Norboard	260		1981						240	260	260	260	260	260	260	260	260	260	260	260				
6	1	Bemidji	Potlatch	155	38	1981	245					90	155	155	160	170	180	190	195	200	220	220	225	230	235	240	240
5	1	Clairmont	Elmendorf	100	30	1981	300					70	100	100	100	100	100	100	50								
10	1	Hayward	L-P	130		1982							100	130	150	160	170	180	180	200	230	230	230	230	230	230	230
51	4	Val d'or	Normick-P	170		1982							85	170	170	170	170	170	170	170	170	170	170	170	170	170	170
50	4	Englehart	Grant	175	33	1982	189						175	175	175	175	175	190	200	200	200	200	200	200	200	200	200
8	1	Houlton	L-P	130	26	1982	200						70	140	150	150	170	175	175	180	185	200	200	200	200	200	200
9	1	Grayling	Weyerhaes	300	85	1982	283						125	300	300	300	300	300	300	300	300	300	300	300	300	300	300
20	2	Dudley	G-P	125		1983								125	125	125	125	125	125	125	125	125	125	140	150	160	160
21	2	Corrigan	L-P	130		1983								100	140	140	140	145	145	145	140	135	135	135	135	140	140
12	1	Easton	Huber	135	28	1983	207							55	135	135	135	135	185	185	185	185	185	185	185	185	185
19	2	LeMoyen	Martin	140	30	1983	214							60	140	160	170	180	180	180	190	220	240	260	260	260	260
11	1	Cook	Potlatch	160	44	1983	275							160	175	180	185	190	190	190	190	190	210	240	240	240	240
40	3	Montrose	L-P	110		1984									110	115	120	125	130	130	120	120	120	120	120	120	120
39	3	Chilco	L-P	90		1984									90	100	110	120	125	130	135	125	125	125	125	125	125
41	3	Kremmling	L-P	110		1984									110	115	120	125	130	130	125	120					
58	5	Edson	Weyerhaes	250		1984									250	250	250	250	250	250	250	250	250	250	250	250	250
22	2	Urania	L-P	120		1984									120	130	135	145	150	130	110	100	100	100	100	100	100
23	2	Grenada	G-P	250		1985										250	265	280	280	280	300	300	300	300	300	310	310
24	2	Skippers	G-P	250		1985										250	265	280	280	280	300	300	330	330	330	349	349
13	1	Two-Harbor	L-P	100		1985										100	110	115	120	125	130	130	130	130	130	130	130
25	2	Dungannon	L-P	110		1986											110	120	120	120	120	120	120	120	120	120	120
26	2	Elkin	Weyerhaes	225	60	1986	267										225	225	225	225	225	225	225	225	225	225	225
60	5	Drayton	Weyerhaes	250		1987												130	250	250	260	265	350	350	350	350	350
28	2	Nacogdoch	I-P	190		1987												120	190	190	190	190	190	200	200	210	210
27	2	Ne Waverly	L-P	100		1987												70	90	90	90	90	90	90	90	90	90
59	5	Dawson Cr.	L-P	250	40	1987	160											250	280	300	345	360	360	380	360	360	360
14	1	Sagola	L-P	260	32	1988	123												260	300	360	360	360	360	360	360	360
52	4	Chambord	Normick-P	260	42	1988	162												200	260	260	260	260	260	260	260	260
29	2	Quitman	Langlade	135	25	1988	185												150	185	185	185	185	185	185	185	185
53	4	Englehart	Grant	315	75	1988	238												165	315	315	315	315	320	325	325	325
30	2	Athens	L-P	320		1989														320	320	320	320	320	320	320	320
31	2	Commerce	Huber	286	50	1989	175													286	286	286	286	286	286	286	286
54	4	St.Michele	Lanofor	285	57	1989	200													285	285	285	290	305	305	305	305
16	1	Newberry	L-P	120		1990															120	120	120	120	120	120	120
15	1	Gr.Rapids	Potlatch	340		1990															340	340	340	340	340	340	340
32	2	Cordele	I-P	305	40	1990	131														305	305	305	305	305	305	305
6	1	Bemidji	Potlatch	220	38	1990	173														220	220	225	230	235	249	249
33	2	Silsbee	L-P	320		1991																320	320	320	320	320	320
34	2	Hanceville	L-P	320		1992																	320	320	320	320	320
17	1	Tomahawk	L-P	120		1993																		120	120	120	120
18	1	Solway	Norboard	50	5.6	1993	112																	310	320	320	320
81	5	100 Mi Hse	Ainsworth	330		1994																			100	300	330
55	4	Limer	Jager	325	75	1994	231																		325	325	325
78	2	Halifax	Huber	300		1995																				300	300
83	2	Jasper	L-P	300		1995																				300	300
38	2	Brookneal	G-P	325		1995																				325	325
36	2	Mt.Hope	G-P	325		1995																				150	325
37	2	Tupelo	Norboard	400	80	1995	200																			400	400
65	2	Carthage	L-P	300		1996																				300	300
80	2	Arcadia	Willamette	400		1996																					300
82	2	Roxboro	L-P	300		1996																					300
56	5	Grand Prai	Weyerhaes	350	82	1996	234																				350
85	5	High praine	Tolko Ind	425		1996																					425
81	4	Swan River	L-P	300	60	1997	200																				
				1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
TOTAL				290	470	570	695	695	845	995	1155	1385	1990	2740	3620	4590	5365	5901	6701	7591	8797	9662	9737	10057	10472	11046	13414	14994
CHANGE				290	180	100	125	0	150	150	160	230	605	750	880	970	775	536	800	890	1206	865	75	320	415	574	2368	1580
Number of Mills								7	8	9	10	12	17	21	26	31	34	36	40	43	45	48	48	47	49	52	58	62
Avg. mill capacity								114	106	111	116	115	117	130	139	148	158	164	168	177	195	201	203	214	214	212	231	242

Table 3—Particleboard capacity—by year of construction

Plant	Region	State	Location	Company	Initial Capac. MMSF	Cost Mil. $	Year Built	Capac. Cost $/MSF$	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982/83	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	1	Ala	Hunstville	Giles-Kend					7	7	7	7	7	7	7	7	7	7	7	7	7	7	10	10	10		12	10	18	18	6	6	6	6	6
51	3	Ca	Arcata	Sierra-P / L-P					45	45	45	70	70	70	70	70	70	70	85	170	150	125	125	125	125		78	78	100	100	115	120	130	130	130
5	1	Ark	Crossett	G-P					36	42	42	42	63	63	63	63	72	72	105	105	105	128	120	135	95										
31	2	PA	Tyrone	Westvaco					25	25	25	25	25																						
47	2	WI	Marinette	Rodman					15	15	15	20	20	24	24	24	24	24	24	24	24	25	18	25	24		35	35	35	35	43	43	43	43	43
70	3	OR	N Bend	Weyerhae					35	35	35	35	35	35	35	35	70	70																	
65	3	OR	Brownsville	Browns/Forr					30	30	30	30	30	30	30	30	30	30	10																
56	3	Ca	Redding	Champion					65	70	70	70	70	70	70	70	70	70	70	85															
71	3	OR	Medford	Timber prod					40	40	40	60	60	60	60	60	80	80	80	81	81	76	80	84	96		96	96	96	96	96	96	96	96	96
54	3	Ca	Crescent city	Hambro					12	12	12	12	23	23	23	23	23	23	25	26	28	28	34	35	30		25	30	30	35	35	36	36	35	35
30	2	NY	Jamestown	Flakeboard					23	23																									
52	3	Ca	Chester	Collins Pine					24	24	24	24	24	24	24	24	24	24	25	28	32	30	38	36	36		38								
57	3	Ca	Redlands	Golden State					26	26	26	26	26	30	30	30	36	36	36																
73	3	OR	White City	Down River					63	45	45	45	45	45	45	45	45	45	45	75	70	70	50	80	75										
66	3	OR	Dillard	Permaneer					25	25	25	25	25	25	25	25	30	30	30	30															
67	3	OR	Eugene	Boh/William					33	36	36	50	50	50	50	50	50	50	66	66	65	65	65	65	65		80	72	72	74	75	80	80	80	80
75	3	OR	Sweet Home	Publishers					12	12	12	12	12	12	20	20	20	20	20	15	15	13	16	16											
79	3	WA	Longview	I-P					6.6	6.6	6.6	12	12	12	10	10	10	10	10	11	11	11													
19	2	MI	Gaylord	Champion					40	40	40	40	100	100	100	100	108	108	108	108	108														
48	2	WI	Antigo	Wynnewood					18	20																									
8	1	Ark	Hope	S. Plaswood					12	12	12	12	14	14	14	14	14	14	14																
41	1	Va	South Boston	Champion					30	30	30	30	30	30	30	30	30	30	64	64	70	75	77	84	84		100	100	108	108	108	108	108	108	108
40	1	Tx	Jacksonville	Wynnwood					12	12	12	12	12	12	12	12	12	18	18	18															
6	1	Ark	Trumann	Singer					6	5	5	5	5	5	10	10	15	22	22	22	15	22	20	16	22										
43	1	Va	Waverly	Masonite					60	60	60	60	60	60	60	60	60	60	60	80	80	90	90	97	97	100		96	96	97	98	98	98	103	100	100
29	1	NC	Farmville	Formica-IP					40	40	40	40	40	60	70	70	70																		
14	2	Ind	Seymour	Swain			1947		12	12	12	12	12	12	12	12	15	15	15	15	15	15	15	15	15		15	15	17	17	17	17	17	17	17
22	1	MS	Meridien	Kroehler			1959		7.2	12	12	12	12																						
63	3	OR	Albany	Willamette			1960		90	90	100	100	100	100	166	166	166	166	166	169	177.5	176	171	168	171		178	170	180	189	190	190	212	215	215
78	3	OR	Oakridge	Pope-Talb			1963		24	24	24	24	30	30	30	30	30																		
27	1	NC	Lenoir	Nu-Wood			1964		6	7.5	7.5	7.5	15	15	15	15	15	15	17	17	17	25	23	24	24		24	24	24	24	24	23	23	16	16
76	3	OR	Springfield	Weyerhae	30		1965		30	30	30	30	30																						
64	3	OR	Bend	Brks-Wilia	45		1966			45	45	45	45	110	110	110	110	110	140	140	145	143	150	135	140		142	150	170	170	170	170	170	170	170
69	3	OR	LaGrande	Boise	65		1966			65	65	65	65	65	120	120	150	150	150	150	153	166	152	153	154		166	178	181	180	180	184	187	187	185
15	1	Ky	Middlesboro	Tenn-Flake			1967				30	50	50	50	50	50	50	50	50																
49	2	WI	Marshfield	Weyerhae	38		1967				38	38	38	38	38	60	60	60	62	62	64	70	63	66	65		64	64	64	70	70	70	70	70	70
23	1	MS	Louisville	G-P	60		1967				60	72	72	72	72	90	90	90	90	91	91	106	90	100	74		67	94	97	124	124	103	103	118	118
36	1	TX	Silsbee	Evans Pr	70		1967				45	70	70	72	72																				
10	1	Ga	Adel	Weyerhae	35	5	1968	142.9				35	35	35	35	50	50	50	50	75	75	75	70	70	75		75	75	75	75	86	89	92	92	93
7	1	Ark	Malvern	I-P	70	6.5	1968	92.9				70	70	70	70	70	70	70	70																
12	1	Ga	Vienna	G-P	75	5	1969	66.7					75	75	90	90	90	90	90	100	102	102	105	105	105		108	112	114	116	120	118	114	112	115
24	1	MS	Oxford	Champion	100	7.5	1969	75.0					100	100	100	110	110	115	120	120	120	120	131	152	155		175	193	200	200	200	200	200	200	175
61	3	NM	Albuquerque	Mexwood	30		1970							30	30	30	30	30	30	45	45	42	45	45	45		45	48	48	48	48	45	50	50	50
77	3	OR	Springfield	Weyerhae	60	8	1970	133.3						90	90	90	90	90	90	100	105	105	100	105	100		96	96	96	96	100	105	130	130	130
33	1	SC	Greenwood	I-P	70	6.5	1970	92.9						70	70	70	70	70	70																
50	3	AZ	Flagstaff	SWFI	75	6	1970	80.0						75	75	75	75	75	75																
60	3	MT	Missoula	Evans Pr/L	80	9	1970	112.5						80	80	80	80	85	90	96	96	100	96	100	100		96	96	100	150	150	150	150	150	150
72	3	OR	Roseburg/Dil	Roseburg			1971								100	100	100	100	150	276	276	278	288	288	288		300	300	315	340	340	340	350	350	350
68	3	OR	Klamth Falls	Weyerhae	56	8	1971	142.9							56	56	72	72	95	95	95	96	93	95	100		100	100	100	100	100	104	104	105	105
16	1	La	Urania	G-P / L-P	72	7	1971	97.2							72	72	95	95	95	95	90	90	90	90	100										
25	1	MS	Taylorsville	G-P	73		1971								73	73	120	120	120	120	120	120	112	105	86		72	105	107	110	113	120	116	125	125
39	1	Tx	Diboll	Temple	80		1971								80	80	80	80	100	100	90	90	100	100	100		90	102	105	105	105	110	110	114	110
34	1	SC	Russellville	G-P	95		1971								95	95	95	95	95	120	108.5	111	108	105	108		110	120	126	126	122	125	125	125	125
17	1	La	Lillie	Olinkraft	100	8.5	1971	85.0							100	100	100	100	100	100	100	100	100	100	100		100	89	95	100	100	100	100	105	110
53	3	Ca	Chowchilla	Wickes	35		1972									16	32	32	32	36	34	37	36	36	37										
18	1	La	Ruston	Willamette	50	7	1972	140.0								60	60	60	60	68	64	62	65	66	60		82	84	90	97	97	97	102	102	100
45	1	Va	Franklin	Union Cam	60	6	1972	100.0								60	60	70	70	84	84	76	78	80	75		87	85	87	90	92	92	90	90	90
58	3	Ca	Ukiah	G-P/L-P	80	7.5	1972	93.8								80	80	80	80	81	80	80	80												
55	3	Ca	Martell	AFPC	90	10	1972	111.1								90	90	90	90	95	96	93	97	115	110		105	115	115	130	130	140	140	140	140
13	2	Ind	Evanston	Swain			1973										12	12	12	12	12	12	11	13	15		12	15	18	18	18	18	18	18	18
9	1	Fla	Greenville	Fla-ply			1973										10	10	10	10	10	8	24	16	11		17	17	14	14	14	14	17	17	17
42	1	Va	Stuart	Stuart C/Mas			1973										60	60	60	60	60	50	45	55	60		55	55	55	76	76	76	78	78	78
38	1	Tx	Corrigan	G-P / L-P	90		1973										45	90	90	100	100	100													
4	1	Ala	Pine Hill	McM-Bloed			1974											100	100	100	100	100	100												
3	1	Ala	Monroeville	Olinkraft			1974											20	80	105	100	100	100	100	100		104	100	120	120	115	115	120	120	120
21	2	Min	Virginia	Publishers			1974											12	12	12	12	8	8	8											
37	1	TX	Silsbee	Kirby	70	11	1974	157.1										70	70	70	72	72	72	72	72		72	72					70	70	70
11	1	Ga	Thomson	Temple	100		1974											30	100	100	90	100	100	100	100		90	108	102	102	102	105	105	109	109
2	1	Ala	Eufala	L-P			1975												108	108	100	100													
59	3	Id	Post Falls	Potlatch	50	4.5	1975	90.0											50	57	60	68	68	68	72		75	75	75	76	76	76	75	73	73
74	3	OR	Philomath	Publishers			1976													16.7	17	19	17	17	20		22	22	28	28	28	28	28	28	34
26	1	NC	Lenoir	Broyhill			1976													27	42	27	20	25	25		25	31	31	31	31	29	28	30	30
62	3	NM	Navajo	Navajo FP	30	9.9	1976	330.0												30	30	30	29	29	25		36	38	38	38	38	36	40		
20	2	MI	Gaylord #2	Champion	164	32	1978	195.1														164	172	180	175		200	200	207	207	250	241	241	240	240
35	2	SD	Rapid City	Merrillat			1984																				88	85	85	87	94	95	95	105	105
46	1	Va	Galax	Webb	18		1985																					18	15	16	16	14	15	16	16
44	1	Va	Ridgeway	Triwood, In	20		1985																					20	20	20	20	20	20	20	20
28	1	NC	Moncure	Weyerhae	90		1987																							90	90	90	95	105	105
32	2	PA	Mt Jewett	Allegheny	186	115	1990	618.3																									186	186	186
			Others						125	120	100	80	70	50	50	50	50	50	50	50	50	50	50	50	50		40	40	40	40	40	40	40	20	20
					1962	1963	1964		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1983/83	1984	1985	1986	1987	1988	1989	1990	1991	1992
			TOTAL		610	650	750		1035	1143	1263	1475	1747	2100	2833	3132	3482	3892	4078	4323	4170	4249	4022	3959	3894	na	3873	3808	3910	4184	4262	4276	4628	4616	4598
			CHANGE			40	100		285	108	120	211	273	353	733	299	350	210	386	245	-153	80	-227	-63	-65	na	3873	135	102	274	78	14	352	-12	-18
			Number of Mills		40	40	39		41	46	46	46	51	55	59	62	62	62	58	21	18	17	16	16	15	na	12	11	11	11	11	11	11	11	11
			Avg. mill capacity		15	16	19		25	25	27	32	34	38	48	51	56	60	70	206	232	250	251	247	260	na	306	346	355	380	387	389	421	420	418

Table 4—Canadian particleboard plant capacity—by year of construction

Plant	Region	Province	Location	Company	Initial Capac. MMSF	Cost MIL $	Year Built	Capac. Cost $/MSF	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	4	ON	Sturgeon F	Abitibi			1958		20	20	20											
6	4	NB	St Stephen	Flake Bd			1960		20	20	20	25	34	30	27	27	27	27	27	27	27	30
4	4	QU	Lac des Iles	Sogefors			1960		15	15	15	40	40	40	45	45	50	55	55	55	55	52
9	5	BC	Vancouver	McM-Bl			1962		21	21	21	32	40	40	40	44	44	48	48	50	52	52
2	4	MA	Sprague	Weldwood			1962		12	12	12	20	20	21	20	20	20	20	20	20	20	
13	4	ON	New Liskeard	Rexwood			1964		10	10	25	25	25	25	25	30	30	35	35	35	35	35
7	4	QU	Val d'Or	Forpan			1964															85
14	4	ON	Timmins	Mallette			1972									36	36	36	36	36	36	36
5	4	ON	Huntsville	Domtar	42	18	1974	429											42	42	42	42
12	4	ON	Atikokan	Proboard			1976													45	45	45
8	4	ON	Hearst	Levesque			1976													45	45	45
3	5	BC	Grand Forks	CanPar			1976															20
10	5	BC	Smithers	Northwest P			1983															
11	4	QU	Sayabec	Panval			1984															
15	4	ON	Bancroft	Combiboard			1991															
16	4	QU	Lac-Megan	Tafisa			1992															

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
TOTAL	98	98	113	142	159	156	157	202	207	221	263	355	357	442
CHANGE		0	15	29	17	-3	1	45	5	14	42	92	2	85
Number of Mills	6	6	6	5	5	5	5	6	6	6	7	9	9	10
Avg. Mill Capacity	16	16	19	28	32	31	31	34	35	37	38	39	40	44

Plant	Region	Province	Location	Company	Initial Capac. MMSF	Cost MIL $	Year Built	Capac. Cost $/MSF	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	4	ON	Sturgeon F	Abitibi			1958															
6	4	NB	St Stephen	Flake Bd			1960		40	40	40	40	40	45	70	80	80	80	82	84	84	84
4	4	QU	Lac des Iles	Sogefors			1960		62	62	65	67	67	90	90	90	90	60				
9	5	BC	Vancouver	McM-Bl			1962		54	54	54	54	54	54	54	54	57	57	55	54	56	56
2	4	MA	Sprague	Weldwood			1962															
13	4	ON	New Liskeard	Rexwood			1964		35	35	35	35	35	40	40	45	65	65	65	65	65	65
7	4	QU	Val d'Or	Forpan			1964		85	85	85	85	120	130	140	140	140	150	155	163	170	170
14	4	ON	Timmins	Mallette			1972		36	36	36	36	36	36	36	36	38	32	30	28		
5	4	ON	Huntsville	Domtar	42	18	1974	429	42	42	45	45	45	45	45	45	50	50	75	100	100	100
12	4	ON	Atikokan	Proboard			1976		50	50	55	70	70	70	70	70	70	70	62	62	62	62
8	4	ON	Hearst	Levesque			1976		45	55	55	55	55	55	58	58	58	58	57	57	62	62
3	5	BC	Grand Forks	CanPar			1976		30	30	40	40	40	42	42	45	45	65	65	71	83	83
10	5	BC	Smithers	Northwest P			1983					50	45	43	42	40	35	35	30	25	25	25
11	4	QU	Sayabec	Panval			1984						100	100	100	100	100	100	110	120	120	120
15	4	ON	Bancroft	Combiboard			1991													106	106	106
16	4	QU	Lac-Megan	Tafisa			1992														83	83

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	479	489	510	577	707	750	787	803	828	822	786	935	1016	1016
CHANGE	29	10	21	67	130	43	37	16	25	-6	-36	149	81	0
Number of Mills	10	10	10	11	13	13	13	13	13	13	12	13	13	13
Avg. Mill Capacity	48	49	51	52	54	58	61	62	64	63	66	72	78	78

Table 5—MDF plant capacity—by year of construction

Region	State	Location	Company	Initial Capac. MMSF	Cost MIL $	Year Built	Capac. Cost $/MSF	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	NY	Deposit	Norbd			1966		28	28	28	28	28	28	28	28	28	28	28	28	25	25	28	28	28				55	55	55	55	54	55	55	55	55
2	VA	Bassett	Bassett			1969					20	20	20	20	20	20	22	24	24	22	22	22	22	22	22	22	22	22	22	21	21	21	21	21	21	21
2	MS	Meridian	Kroehler			1970						18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5																
1	OR	Oakridge	Pope-Talb			1971							30	30	30	43.8	43.8																			
2	NC	Moncure	Weyer.	62	12.0	1971	193.5						62	62	62	62	62	62	60	60	60	60	60	60	60	70	70	70	70	70	70	75	80	80	80	80
2	OK	Broken Bow	Weyer.			1972								72	72	72	72	72	85	70	70	70	70	70	71	75	75	75	75	127	127	30				
2	NC	Spring Hope	Masonite			1973									40	55	60	70	70	72	74	74	74	74	74	72	74	62	62	62	62	67	69	69	69	70
1	MT	Columbia F	Plum Cree	70	10.5	1974	150.0									70	70	70	70	75	76	80	80	80	80	80	80	80	85	88	87	100	110	110	110	110
2	SC	Marion	Masonite	57	11.0	1974	192.0									57.3	57.3	57.3	57.3	55	55	57	57	57	57	57	57	57	57	57	57	63	63	63	63	63
2	SC	Holly Hill	HH>G-P			1975											50	50	50	60	60	62	62	62	81	81	81	81	81	100	96	100	100	100	100	100
1	OR	Medford	Medite	65	13.5	1975	209.3										64.5	64.5	70	80	80	80	80	80	85	85	85	88	88	93	95	100	96	96	96	96
1	CA	Oroville	L-P			1975											50	50	50	50	50	50	50	50	50	50	50	50	50	44	44	44	44	44	44	44
1	CA	Rocklin	Fiberboard	60	10.0	1976	166.7											60	60	60	68	75	75	75	80	80	75	80	82	82	88	88	85	88	88	88
2	Ala	Eufala	L-P	60	17.0	1979	283.3														60	60	60	60	60	70	70	70	70	120	120	125	125	130	130	130
4	AL	White Court	Blue Ridge			1981																	45	51	51	51	51	51	60	60	60	60	60	60	60	60
2	Ark	Malvern	Willam.	49	19.0	1983	387.8																		40	45	49	58	120	120	120	120	120	120	120	120
1	NM	Las Vegas	Medite	80	27.0	1984	337.5																			80	80	80	80	85	90	90	90	90	90	90
3	MI	Newberry	L-P	50	20.0	1985	400.0																				50	50	50	60						
4	QU	Mont-Laurier	Panfibre			1986																						60	60	60	60	63	63	63	63	63
2	SC	Bennetsville	Willam.			1990																										100	100	140	140	140
4	NB	St. Stephen	Flakebd.	40	20.0	1991	500.0																										40	48	55	55
2	LA	Urania	L-P			1993																													50	60
1	WA	Shelton	Hokushin	80	50.0	1994	625.0																													80

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
TOTAL	28	28	28	48	67	159	231	271	427	598	626	643	648	700	718	763	769	811	918	969	1089	1167	1304	1252	1300	1321	1377	1434	1525
CHANGE		0	0	20	19	92	72	40	156	172	28	17	5	53	18	45	6	42	107	51	120	78	137	-52	48	21	56	57	91
Number of Mills	1	1	1	2	3	5	6	7	9	12	12	12	12	12	12	13	13	13	14	15	17	17	17	16	17	17	17	18	19
Average Mill Capacity	28	28	28	24	22	32	38	39	47	50	52	54	54	58	60	59	59	62	66	65	64	69	77	78	76	78	81	80	80

Table 6—Southern Pine Plywood plant capacity—by year of construction

State	Location	Company	Initial Capac. MMSF	Cost MIL $	Built Year	Capac Cost $/MSF	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Ark	Fordyce	G-P	90		1964		60	90	120	120	120	135	135	150	150	150	150	150	170	180	190	190	200	225	230	230	255	255	255	260	285	290	285	285	285
Tex	Silsbee	Kirby	36		1964		36	36	40	50	60	60	60	120	120	120	120	120	120	130	145	150	150	150	150	150	150	160							
Tex	Diboll	SPPCo>TE	70		1964		50	70	70	70	70	70	70	70	120	120	120	120	120	120	120	120	120	120	125	125	125	50							
Ala	Fulton	Scotch	45		1965			45	60	60	80	80	100	100	100	100	100	100	130	153	153	153	180	200	230	230	230	240	240	240	265	265	265	265
Ark	Crossett1	G-P	120		1965			60	130	130	130	145	155	155	155	155	175	200	200	200	200	200	200	200	220	240	240	250	275	300	305	310	315	315	315
La	Oakdale	Vanply>BC	100		1965			60	100	100	125	125	125	125	125	125	125	165	165	165	165	165	165	175	175	175	175	175	185	200	250	260	260	260	285
La	Florien	Vanply>BC	100		1965			50	100	100	125	125	125	125	125	125	125	165	165	165	165	165	165	175	175	175	175	175	185	225	266	290	295	297	297
La	Ruston	Santmp>Wil	60	3	1965	50		35	70	70	80	80	80	85	85	85	85	85	85	85	85	85	85	85	85	85	100	115	130	130	130	130	150	175	175
NC	Plymouth	Weyerh	72	4	1965	56		60	72	72	72	72	72	72	72	72	72	72	80	80	80	80	80	80	80	80	100	100	100	110	110	110	110	110	110
Tex	Kellys	Angel>L-P	60		1965			50	72	72	72	72	72	72	72	72	72	72	100	100	100	100	100	110	140	140	140	155	170	170	170	190	190	190	190
Ark	Crossett2	G-P	130		1966				90	130	130	145	145	150	155	155	155	175	200	200	200	200	200	200	220	240	240	250	275	300	310	315	320	320	320
Ga	Savannah	G-P	55		1966				40	55	75	75	100	100	100	100	100	100	100	100	100	100	100												
La	Hammond/Ho	USPly>Cl	100	5	1966	50			50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100									
La	Minden	Col>Willam	60		1966				20	60	80	80	80	80	80	80	80	85	85	85	85	85	85	85											
La	Winnfld	Olin-Math	60	3	1966	50			30	60	60	60	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	120	160	180	170	170	170	185
La	Dodson	Hunt>Willa	80		1966				20	80	80	130	130	130	130	130	130	130	130	130	130	130	130	130	150	150	150	150	160	180	190	197	196	196	196
La	Haynesv	Santiam	30		1966				30	30	30	30	30	30	30	30	30	30	30	30	30	30													
Md	Pocomoke	USPly>Che	60	5	1966	83			60	60	60	60	60	60	60	60	60	60	90	90	90	90	90	90	90	90	90	90	100	100					
Ms	Philadel	Weyerh	30	1.5	1966	50			30	30	55	55	55	55	55	55	55	55	55	55	55	55	55	65	65	65	75	75	85	85	85	85	85	85	85
Ms	Louisville	G-P	90		1966				50	90	90	90	90	90	150	150	150	150	167	188	200	200	200	280	280	280	280	280	290	290	290	290	292	292	292
Ms	Beaumont	Del Pn>Hd	90	4.2	1966	47			60	90	90	90	90	90	90	90	90	90	90	95	100	100	100	100	100	100	100	120	120	140	140	140	140	140	140
NC	Eliz. Cty	Triang	30		1966				10	30	30	30	30	30	30	30	30	30	30	30	30														
NC	Jacksonv	Weyerh	60	3.1	1966	52			25	60	60	100	100	100	100	100	100	100	100	100	100	130	130	130	130	130	130	158	158	165	160	160	154	155	155	155
Va	Emporia	G-P	90		1966				90	100	110	130	150		160	160	160	160	160	160	160	160	160	160	160	200	230	250	250	265	265	290	295	300	317
Ala	Chapman	Union-Cam	120	5.2	1967	43				90	120	120	120	120	120	120	120	120	150	180	190	190	190	190	190	190	200	210	210	210	205	210	210	210	
Ark	Gurdon	Arida	100		1967					40	120	120	120	120	120	120	120	120	120	120	120														
Fla	Chiefland	G-P	90		1967					60	90	90	90	90	90	90	90	90	90	90	90	90	90												
La	Natchitoch	SPly>Will	60	2.5	1967	42				45	60	60	75	75	75	75	75	75	85	85	85	85	85	85	85										
La	Joyce	Tremnt>CZ	70		1967					35	70	70	85	85	85	85	85	85																	
Ms	Gloster	G-P	90	4	1967	44				90	90																								
NC	Moncure	Triang/BC/	60	3	1967	50				50	80	80	80	80	80	80	80	84	84	84	84	84	84	84	90	90	90	95	95	95	95	108	110	110	110
Ala	Pine Hill	McM-Bloed	120		1968						80	120	120	120	120	120	120	135	150	150	150	150	150	150	150	150	150	160	160	160	135	135	138	140	
Ga	Cedar Spr.	Gt Northn	60	4.4	1968	73					60	84	100	100	100	100	100	100	100	100	100	100	100	100	100	110	130	155	165	165	165	160	160	160	160
Ga	Waycross	USPly>Cl	55	3.5	1968	64					55	55	55	55	55	55	55	55	55	75	75	75	75	75	75	75	82	86	90	100	100	100	100	100	98
La	Plain Deal	Anthon>IP	60	2.4	1968	40					40	60	60	60	60	60	60	60	72	72	72	72													
SC	Russelville	G-P	90	4	1968	44					90	110	130	150	150	150	150	150	150	150	150	150	150	150	150	215	225	225	225	240	250	275	275	275	275
Ms	Taylorsvil	G-P	90	6	1969	67						50	90	190	190	190	190	190	190	190	190	190	250	250	250	250	245	245	255	300	350	350	345	345	345
Ms	Gloster	G-P	50	2.1	1969	42						100	140	175	175	175	175	175	190	200	210	210	230	230	230	230	240	270	280	280	280	280	280	280	280
Tex	Nacogdoch	I-P	100		1969							70	100	100	100	100	100	125	150	160	160				160	160									
Ala	Cordova	Champion	50		1970								25	50	55	55	60	70	70	75	75	80	85	85	90	90	90								
Ala	Andalusia	Independ	60		1970								30	60	60	90	90	90	90	90	90	90	90	90	90	90									
Ga	Monticello	G-P	120		1970								60	120	120	120	180	200	220	240	250	260	260	260	270	290	300	300	320	320	320	310	310	310	310
La	Urania	G-P>LP	120	6	1970	50							70	140	140	200	200	200	204	210	220	220	220	220	220	220	220	220	230	230	250	270	270	270	270
Ala	Livingston	Sumter>MBI	90	5.5	1971	61								45	90	100	100	100	100	100	100	100	100	100	100	100	100								
Ark	Huttig	OlnM>Manv	70		1971									35	70	70	70	70	75	75	80	80	80	80	80	90	100	100	100						
Ark	Dierks	Weyerh	85		1971									50	85	85	85	85	85	85	85	85	85	85	85	95	110	110	120	120	120	120	120	125	125
Ark	Mt. Pine	Weyerh	85		1971									45	85	85	85	85	85	85	85	85	85	85	85	90	100	110	120	120	120	120	120	120	120
Fla	Pensacola	B-C			1971									60	90	90	90																		
Ms	Wiggins	I-P>Hd	100		1971									50	100	125	125	125	135	145	150	150	150	150	150	150	175	180	190	200	220	220	220	205	
NC	Whiteville	G-P	75		1971									75	85	90	150	150	150	150	150	150	200	200	200	200	240	240	250	270	280	280	280	280	280
Okl	Wright Cty	Weyerh	85		1971									45	85	85	85	85	90	95	100	105	110	110	110	115	120	120	120	120	120	120	120	160	
Tex	Jasper	O-I>L-P	100		1971									50	100	100	100	100	125	140	140	140	140	140	140	140	145	150	150	160	160	150	150	160	160
Tex	New Waver	G-P>L-P	160		1971									100	170	175	180	200	200	200	200	200	210	210	210	210	210	225	240	240	240	270	300	300	300
SC	Holly Hil	Holly H.	100	6.5	1972	65									50	100	100	100	100	100	100	100	100	100											
Tex	Corrigan	G-P>Cham	160	10	1972	63									80	160	190	190	200	200	200	200	200	220	230	230	230	230	235	270	290	298	298	300	300
La	DeQuincy	B-C	100		1973											40	100	100	100	100	120	125	125	125	100										
Ga	Warm Spr.	G-P	165	10	1974	61											98	165	185	195	200	200	200	200	200	200	215	215	225	250	290	295	295	295	295
SC	Newberry/SS	USPly/Cl	70		1974												70	150	150	150	150	175	180	180	180	180	185	185	200	229	229	170	175	180	180
Tex	Pineland	Temple	120		1974												120	120	140	140	150	155	155	155	155	195	195	195	205	200	200	200	200	200	200
Ala	Talladega	G-P	120	12	1975	100												130	160	180	200	200	220	220	220	220	226	226	240	250	280	310	310	320	327
SC	Prosperity	G-P	95		1975													95	95	95	95	120	130	140	140	140	140	140	145	175	185	215	225	248	246
Tex	Bon Wier	Kirby>LP	160		1975													160	170	185	200	200	215	220	230	230	230	235	275	275	275	300	300	300	300
La	Joyce	CZ	175	19.6	1976	112													175	175	175	175	188	200	200	200	200	200	200	200	185	185	180	180	185	
Ala	Millport	Weyerh	80		1977															80	80	80	80	80	80	80	90	90	95	100	119	124	125	130	130
Ala	Peterman	G-P	230		1978																200	230	230	230	230	230	230	235	235	265	300	310	310	310	
La	Taylor	Willamett	125		1978																125	130	130	130	130	130	130	150	160	185	210	200	200	210	210
La	Zwolle	Willamett	100	8	1978	80															90	105	105	105	105	107	107	115	150	175	180	185	185	191	
Ark	Emerson	Willamett	150		1979																	125	140	150	150	150	150	160	170	175	180	185	185	190	192
Ark	Gurdon	I-P	150	16	1979	107																150	180	210	230	235	235	245	260	260	260	260	260	260	275
Ga	Madison	GA-Kraft/G	225	25	1979	111																180	225	225	225	235	260	270	275	275	275	310	310	310	310
La	Logansport	G-P/LP	160	21.5	1979	134																120	160	170	170	170	170	190	200	200	200	250	240	250	250
Tex	Camden	Champion	220		1979																	220	230	250	260	260	260	285	300	315	315	317	315	315	315
NC	Dudley	G-P	100	8.5	1980	85																	105	110	140	140	140	140	140	200	215	250	255	257	257
Tex	Cleveland	Kirby>LP			1980																		180	220	250	250	260	280	300	310	320	300	300	300	300
Fla	Havana	Coastal	125		1981																			125	125	125	140	140	140	140	140	140	145	150	160
La	Springhill	I-P	220		1981																			220	220	220	230	250	255	265	280	270	270	270	275
La	Pollock	Hunt	75		1981																			75	80	80	80	125	130	130	130	120	115	110	110
SC	Chester	B-C/Willam	150		1981																			150	150	150	150	155	170	190	215	220	235	262	262
Fla	Hawthorne	G-P	220		1982																				200	200	240	240	250	270	280	275	275	275	275
La	Natalbany	Gulf Coast	120		1988																										60	140	150	155	155
	TOTAL						146	556	1439	2229	2939	3328	3804	4634	5449	5754	6302	6933	7412	7777	8369	9179	9592	10299	10715	10785	10838	10997	11335	11884	12369	12753	12886	13038	13170
	CHANGE						146	410	883	790	710	389	476	830	815	305	548	631	479	365	592	810	413	707	416	70	53	159	338	549	485	384	133	152	132
	Number of Mills						3	10	24	31	36	38	42	51	54	55	58	60	60	61	65	67	66	68	68	66	63	61	59	58	57	57	57	57	57
	Average Mill Capacity						49	56	60	72	82	88	91	91	101	105	109	116	124	127	129	137	145	151	158	163	172	180	192	205	217	224	226	229	231

Table 7—OSB industry variable costs and prices

Year	US$ per thousand ft^2, 3/8-in. basis						
	Power and fuel[a]	Labor and management[b]	Glue and wax[c]	Other costs[d]	Wood[e]	Variable costs	Price
1976	5	12	20	14	21	73	108
1977	5	14	17	14	22	73	116
1978	6	15	13	14	23	71	123
1979	7	16	20	16	24	83	128
1980	8	17	24	18	26	95	109
1981	10	20	25	20	28	102	120
1982	11	23	25	21	28	107	127
1983	11	22	25	21	30	108	140
1984	11	22	25	21	30	109	124
1985	11	21	25	22	31	110	135
1986	10	21	21	20	31	103	129
1987	10	20	24	21	31	106	125
1988	10	20	25	22	33	109	109
1989	10	19	27	23	34	113	147
1990	10	19	21	22	35	106	110
1991	10	18	17	22	36	103	127
1992	10	18	17	23	39	107	187
1993	10	18	18	25	42	113	192

[a]Electricity based on 160 kWh per thousand ft^2, 3/8-in. basis; diesel based on 1 gal per thousand ft^2, 3/8-in. basis; Natural gas varies by region and residue generation.

[b]Census of manufactures, various years.

[c]Resin based on liquid used at 72 to 42 lb (dry) per thousand ft^2, 3/8-in. basis; wax based on 15 to 12 lb per thousand ft^2, 3/8-in. basis; prices are delivered to mill, obtained from suppliers and *Chemical Market Reporter*.

[d]Includes selling and administrative expenses. Costs of capital, taxes, and insurance not included.

[e]Based on 0.87 to 0.72 cord per thousand ft^2, 3/8-in. basis; prices from *Timber Mart South* and various state agencies from northern United States.

Table 8—Particleboard industry variable costs and prices

Year	US$ per thousand ft^2, 3/8-in. basis						
	Power and fuel[a]	Labor and management[b]	Glue and wax[c]	Other costs[d]	Wood[e]	Variable costs	Price
1962	2	9	6	5	7	29	52
1963	2	9	6	5	7	29	52
1964	2	9	6	5	7	29	52
1965	2	9	6	5	7	29	57
1966	2	9	6	5	8	29	51
1967	2	9	6	5	7	29	46
1968	2	10	6	5	8	30	52
1969	2	10	6	5	7	30	62
1970	2	11	7	5	7	31	48
1971	2	11	7	5	7	32	45
1972	2	12	8	5	7	35	48
1973	2	13	11	6	8	41	57
1974	3	14	16	7	9	49	58
1975	4	14	19	8	9	54	54
1976	4	16	16	8	10	54	58
1977	5	17	14	8	11	54	68
1978	6	19	15	9	12	61	110
1979	6	20	17	10	16	70	85
1980	8	22	19	12	17	78	90
1981	10	24	19	13	21	86	94
1982	11	26	19	14	22	92	98
1983	11	27	20	14	20	93	101
1984	11	27	21	14	22	95	109
1985	11	27	20	14	19	92	102
1986	10	28	19	13	19	89	107
1987	9	28	18	13	20	89	113
1988	9	28	21	14	20	92	112
1989	11	29	21	14	21	94	115
1990	11	29	20	14	21	94	108
1991	9	29	20	14	23	95	107
1992	10	29	21	14	24	98	114
1993	10	30	23	15	25	102	135

[a]Electricity based on 160 kWh per thousand ft^2, 3/8-in. basis; diesel based on 1 gal per thousand ft^2, 3/8-in. basis; Natural gas varies by region and residue generation.

[b]Census of manufactures, various years.

[c]Resin based on liquid used at 72 to 42 lb (dry) per thousand ft^2, 3/8-in. basis; wax based on 15 to 12 lb per thousand ft^2, 3/8-in. basis; prices are delivered to mill, obtained from suppliers and *Chemical Market Reporter*.

[d]Includes selling and administrative expenses. Costs of capital, taxes, and insurance not included.

[e]Based on 0.87 to 0.72 cord per thousand ft^2, 3/8-in. basis; prices from *Timber Mart South* and various state agencies from northern United States.

Table 9—Southern Pine plywood industry variable costs and prices

Year	US$ per thousand ft^2, 3/8-in. basis							
	Power and fuel[a]	Labor and management[b]	Maintenance	Glue	Supplies	Net wood	Variable costs	Price
1964	3	13	2	3	4	16	41	54
1965	3	13	2	3	4	16	42	52
1966	3	13	2	3	4	18	44	55
1967	3	13	2	3	4	19	45	49
1968	3	14	3	3	4	20	48	65
1969	3	15	3	3	5	24	53	67
1970	3	16	3	3	5	23	53	55
1971	3	17	3	3	5	27	59	65
1972	4	18	3	3	6	32	65	91
1973	4	19	3	4	6	40	75	94
1974	5	20	4	6	6	42	82	84
1975	6	20	4	7	7	37	81	87
1976	6	21	4	7	7	46	92	116
1977	7	22	4	7	8	55	102	149
1978	7	23	5	5	8	67	116	163
1979	8	25	5	7	9	84	139	154
1980	10	26	5	9	10	75	135	158
1981	12	28	6	9	10	70	135	143
1982	14	30	6	9	11	55	124	142
1983	14	30	6	9	12	60	130	159
1984	14	31	6	9	12	57	129	150
1985	14	32	7	9	13	45	120	145
1986	12	34	7	8	14	44	118	149
1987	12	35	7	9	15	55	132	149
1988	12	34	7	10	15	56	133	141
1989	12	34	7	11	15	57	135	163
1990	12	33	7	9	15	61	136	149
1991	11	33	7	7	15	65	139	143
1992	11	33	7	8	15	75	150	167
1993	11	33	7	9	15	76	153	209

[a]Electricity based on 160 kWh per thousand ft^2, 3/8-in. basis; diesel based on 1 gal per thousand ft^2, 3/8-in. basis; Natural gas varies by region and residue generation.

[b]Census of manufactures, various years.

[c]Resin based on liquid used at 72 to 42 lb (dry) per thousand ft^2, 3/8-in. basis; wax based on 15 to 12 lb per thousand ft^2, 3/8-in. basis; prices are delivered to mill, obtained from suppliers and *Chemical Market Reporter*.

[d]Includes selling and administrative expenses. Costs of capital, taxes, and insurance not included.

[e]Based on 0.87 to 0.72 cord per thousand ft^2, 3/8-in. basis; prices from *Timber Mart South* and various state agencies from northern United States.

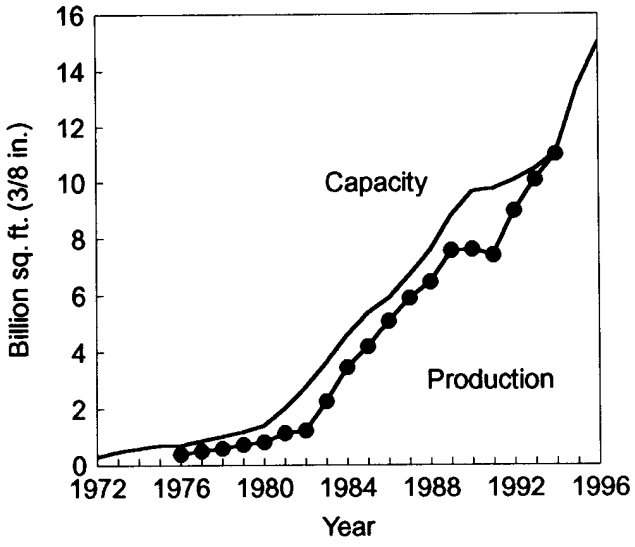

Figure 1—OSB capacity and production in North America.

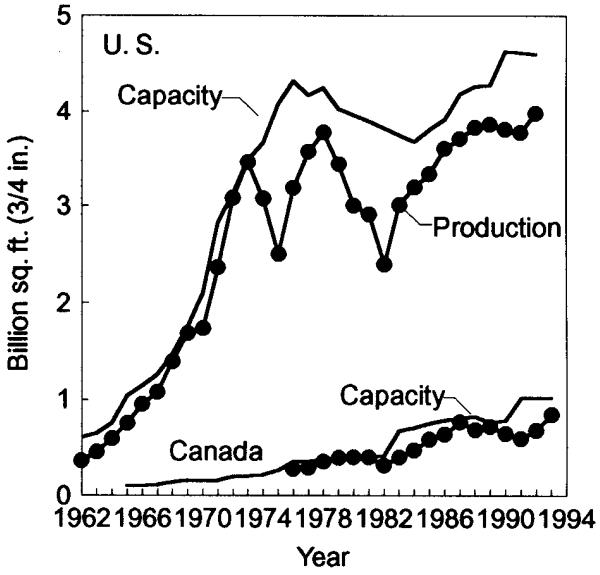

Figure 3—Particleboard and capacity and production in the United States and Canada.

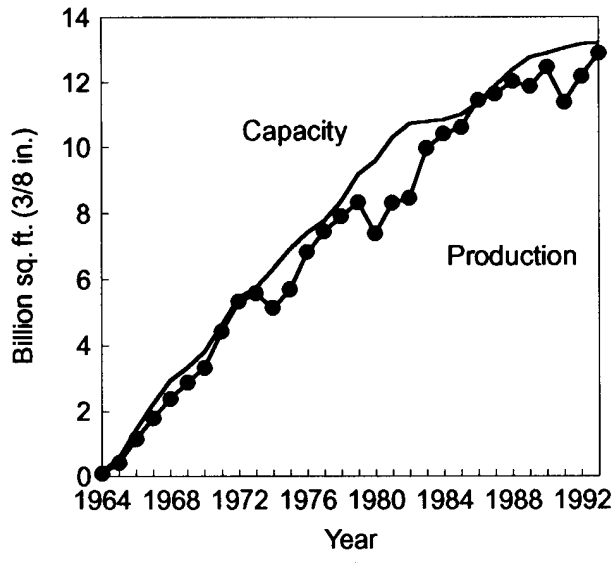

Figure 2—Southern Pine plywood capacity and production in North America.

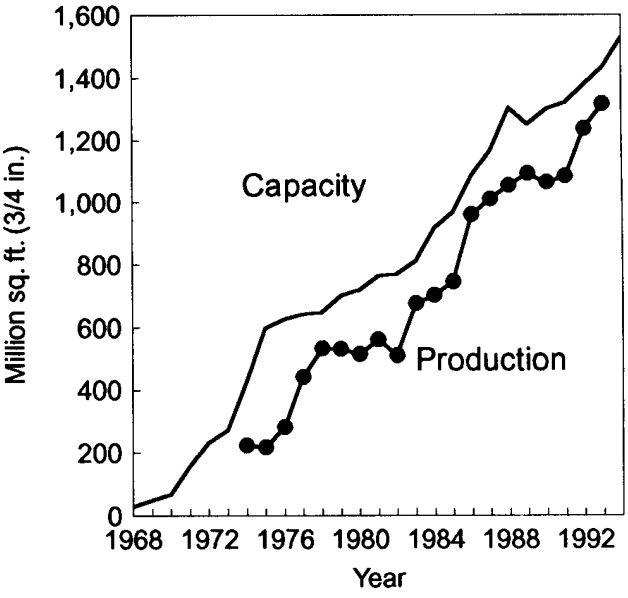

Figure 4—MDF capacity and production in North America.

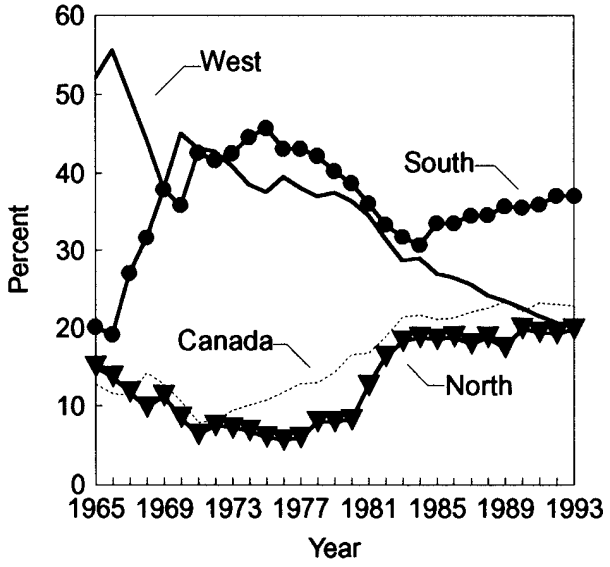

Figure 5—Particleboard, MDF, and OSB shares of capacity, by U.S. region and Canada. Note: shares based on common volumes.

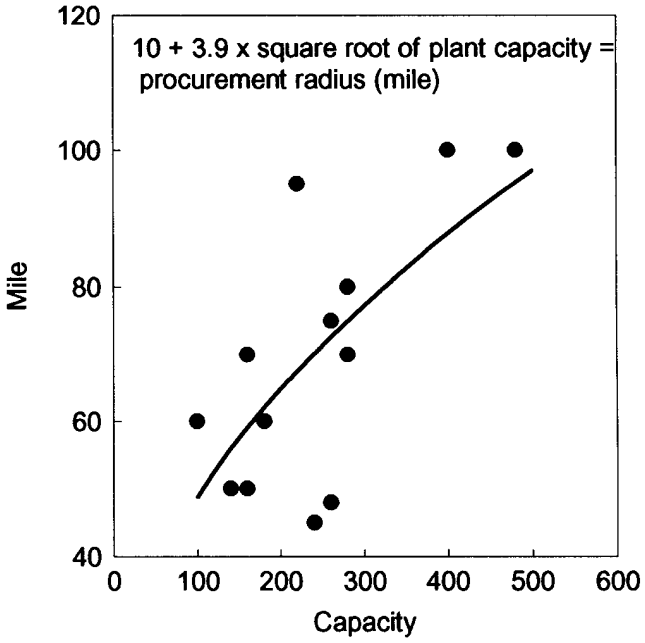

Figure 7—Wood procurement radius compared with OSB plant capacity.

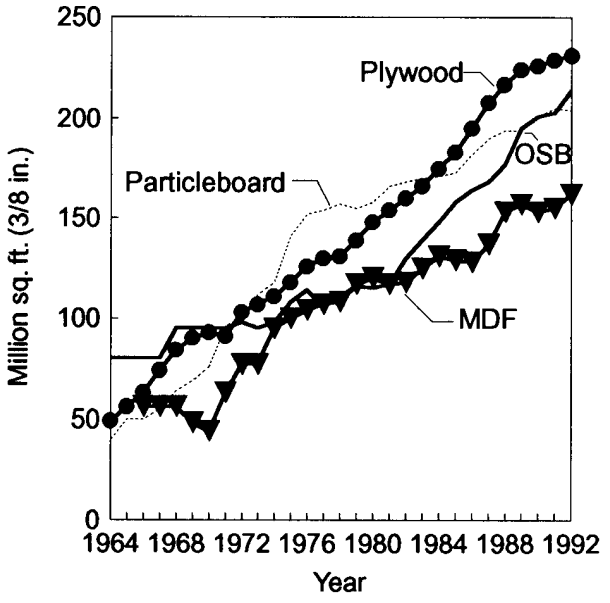

Figure 6—Average capacity per mill.

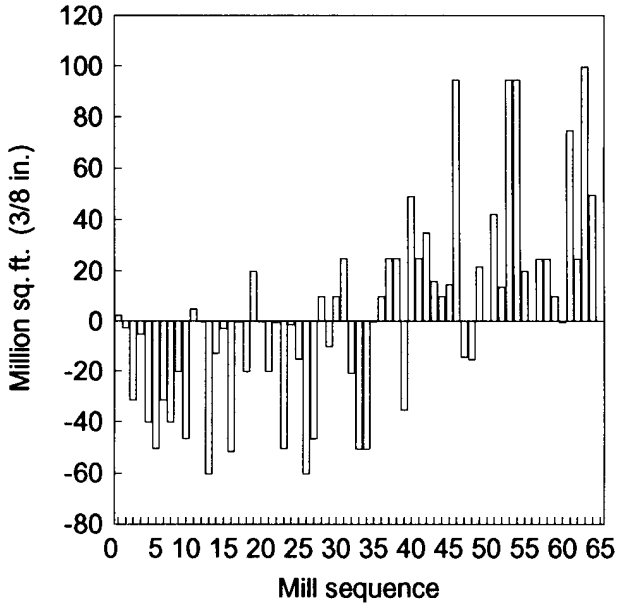

Figure 8—Announced compared with standard capacity; standard based on 5.25-min cycle for 7/16-in. panels.

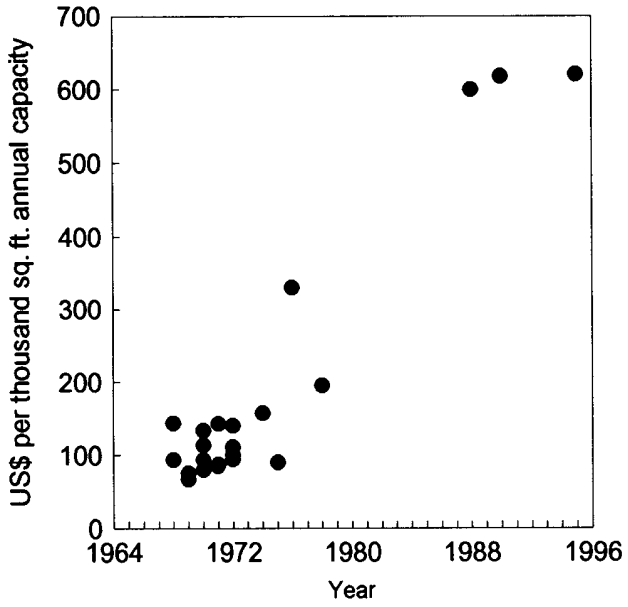

Figure 9—Cost of particleboard mills, by annual capacity.

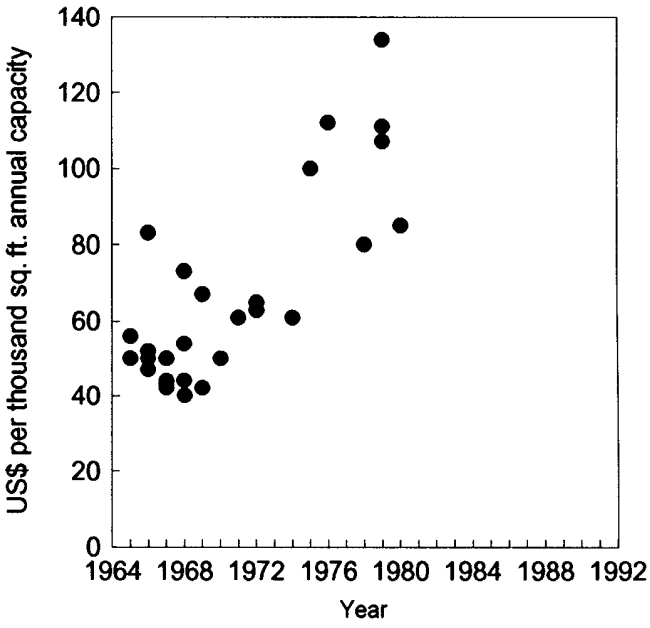

Figure 11—Cost of new plywood mill, by annual capacity.

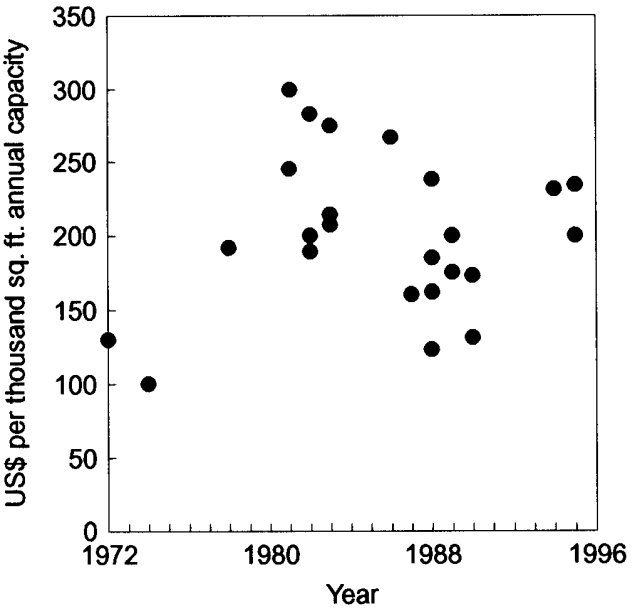

Figure 10—Cost of new OSB mills, by annual capacity.

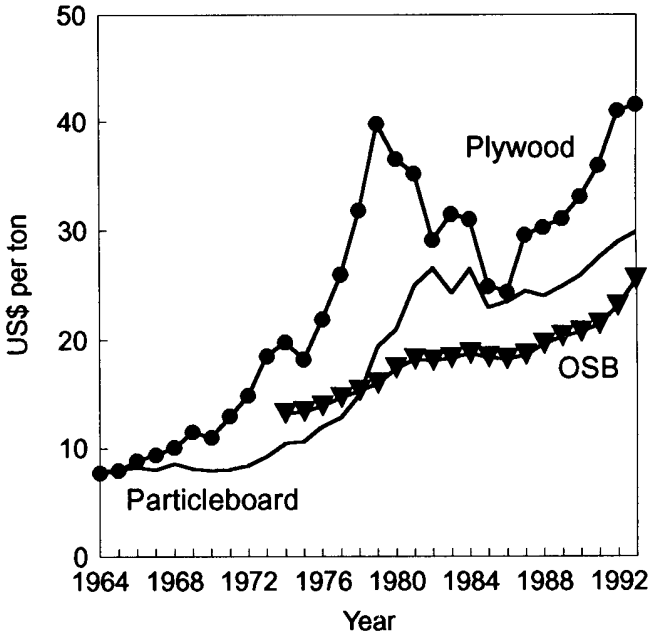

Figure 12—Wood costs by weight.

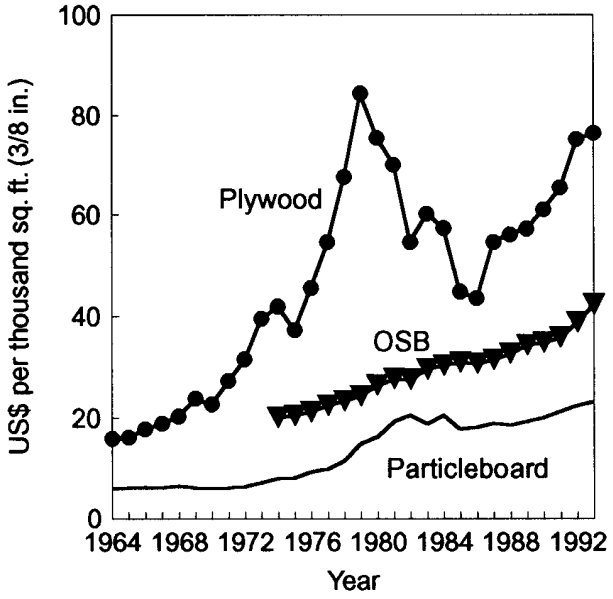

Figure 13—Wood costs by finished product.

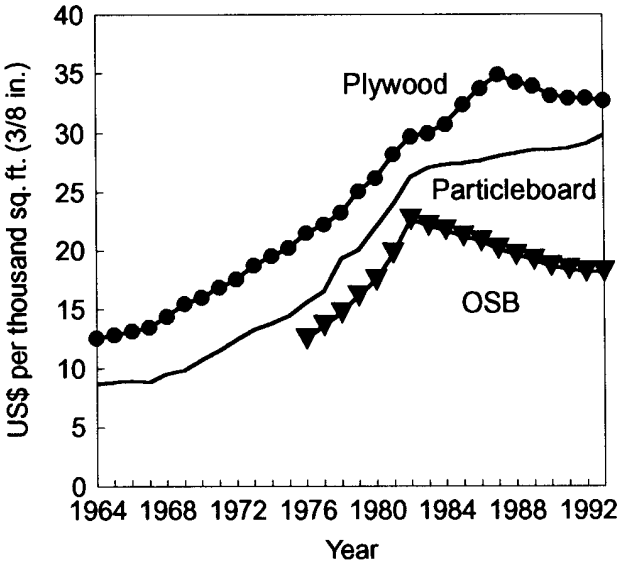

Figure 15—Labor costs by product.

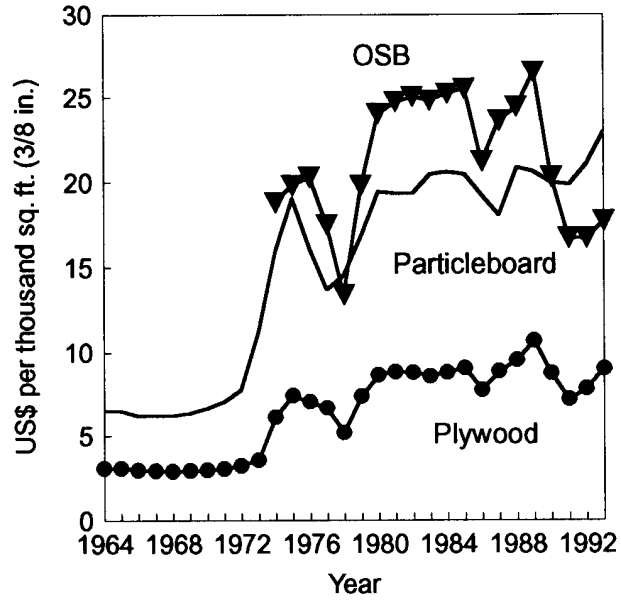

Figure 14—Resin costs by product.

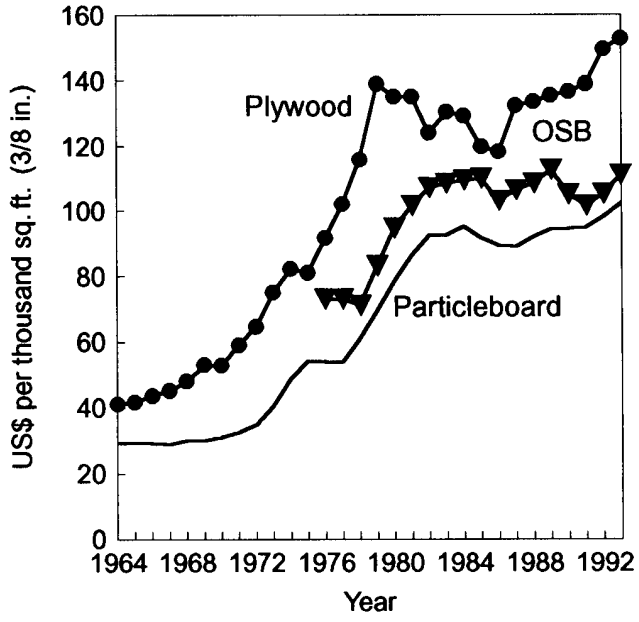

Figure 16—Summary of overall variable production costs by product.

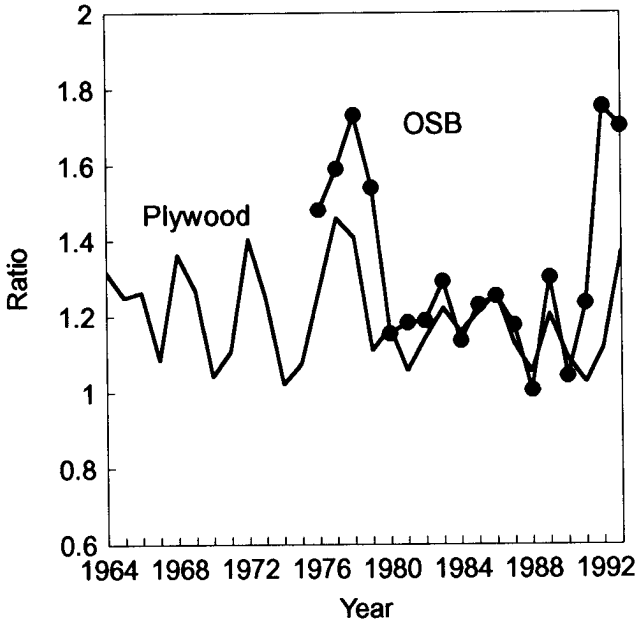

Figure 17—Ratio of variable production costs to market prices equals relative profitability of plywood and OSB.

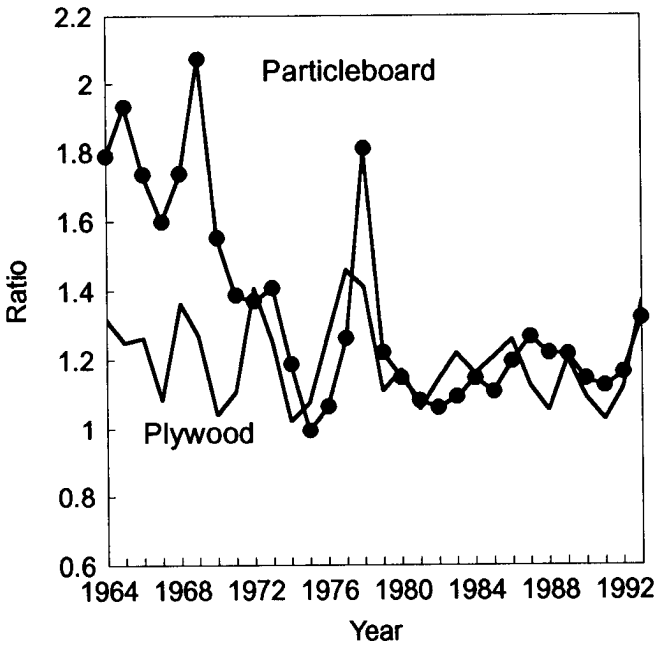

Figure 18—Ratio of variable production costs to market prices equals relative profitability of particleboard and plywood.