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Plywood Manufacturing Cost Trends, Excluding Wood, in Western U.S. Mills: 1975–1988

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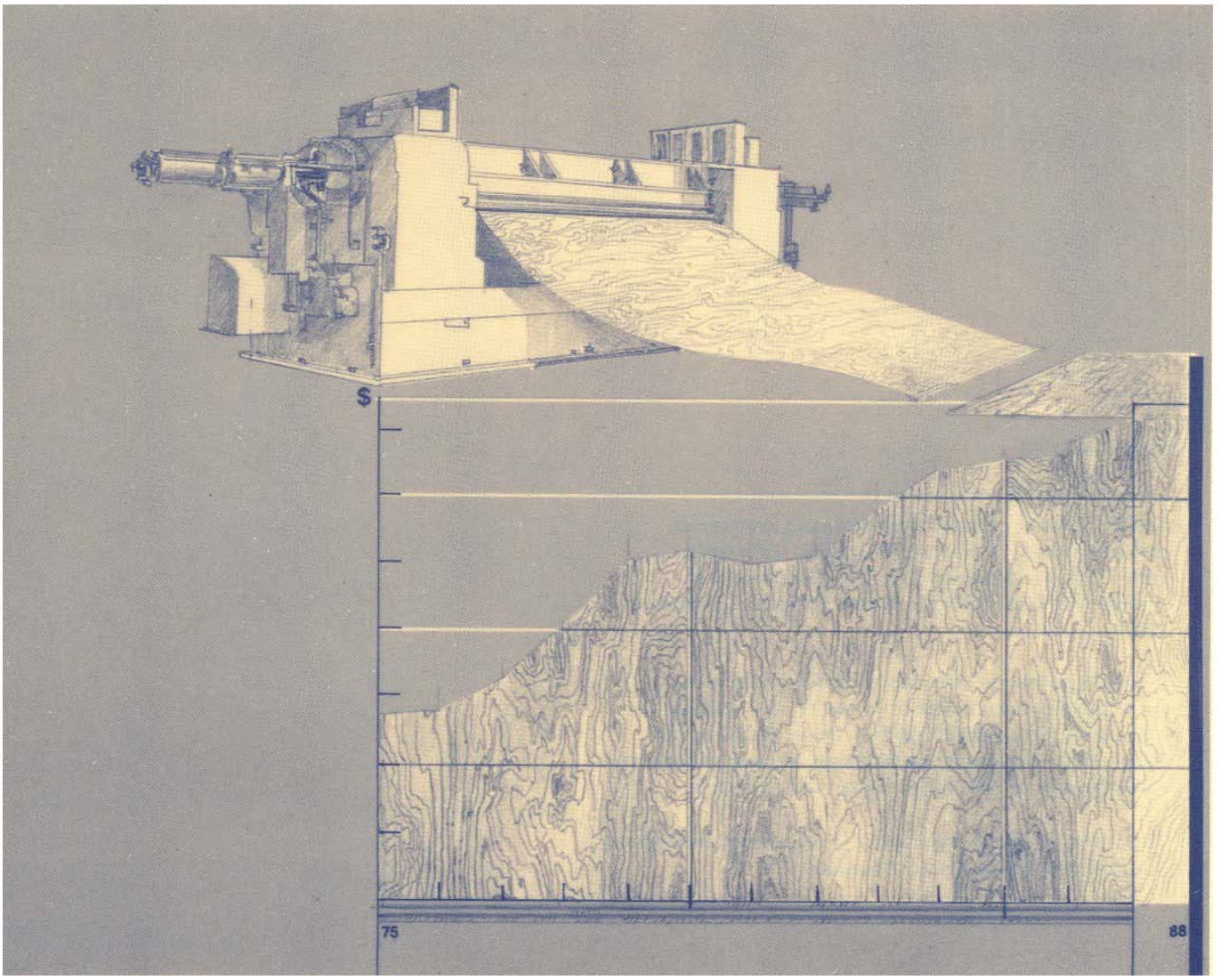

Abstract

Plywood manufacturing costs have increased over the years with inflation. In recent years, new technologies that improve productivity and reduce costs have become available. Cost data published by the American Plywood Association (APA) show moderating rates of increase by 1983. New data from a sample of western U.S. mills show that nonwood manufacturing costs have decreased since the 1983 APA estimates. Costs for sanded-plywood mills declined by 12 to 17 percent between 1983 and 1988, while sheathing costs declined by 8 to 9 percent. Sheathing mills were not included in this analysis. Therefore, these results apply primarily to mills with mixed sanded and sheathing capabilities.

Keywords: Plywood manufacturing, nonwood costs, cost trends

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Introduction

The American Plywood Association (APA) has traditionally collected and published manufacturing cost data from their western and southern members. The costs of obtaining these data were partially paid by the USDA Forest Service because they used this information for timber appraisals on the West Coast. After the Forest Service discontinued its funding in 1981, the APA ceased collecting these data, and their last published report appeared in 1983 (APA 1983). Since 1981, the Forest Service has conducted annual surveys to obtain current manufacturing cost data.

The APA data provided a standard of comparison for mills and a frame of reference for viewing industry cost trends. The discontinuation of these data left an information gap at a time when industry cost structures were changing because of new technology adoption. The potential economic effect of new technologies has been previously examined (Spelter and Sleet 1989), but data on actual industry costs have not been available. This study was undertaken to obtain relatively current data on manufacturing costs and to determine the extent to which costs may have changed since 1983 as a result of new technologies to reduce costs and improve productivity. The data base for this study was the 1988 Forest Service mill survey.

Methods

Mill Sample

The 1988 Forest Service sample consisted of five mills located in western Oregon and Washington. In 1987, these mills produced approximately 1.3×10^9 ft^2 (3/8-in. basis) of plywood, which is 1 ft^2 out of every 7 ft^2 of the plywood produced by the 66 mills in the region (APA 1989). The output of the mills studied leaned heavily to sanded and other specialty items. Sheathing grades (CC, CDX, CDX plugged, and underlayment) were only 22 percent of their output; sanded grades were 43 percent of output. Specialty items such as concrete form, siding, and overlays were 32 percent of output. The remaining 3 percent was shop or reject grade. By comparison, nine mills were classified as sanded in the 1983 APA report.

Data

Two classes of data were compiled from the mills. One class of data was related to costs, the other to sales.

Data on costs were compiled from 11 process centers (Table 1). For each center, volume of wood processed (square feet dry veneer equivalent, 3/8-in. basis) and

Table 1–Volume of wood and cost of processing by process center

Process center	Volume ($\times 10^6$ ft^2)[a]	cost (thousands of dollars)	cost (dollars/10^3 ft^2)
Green end			
Pondyard	1,232	3,830	3.1
Debarker	1,232	3,350	2.7
Lathe, clipping, stacking	1,232	22,444	18.2
Drying	1,304	28,910	22.2
Veneer preparation	1,289	15,715	12.2
Layup and press	1,289	28,165	21.9
Panel trimming	1,289	1,670	1.3
Panel patching and sanding	1,289	12,093	9.4
Warehousing and selling	1,290	6,060	4.7
Oil and edge sealing	766	1,020	1.3
Gluing	1,289	9,575	7.4

[a] 3/8-in, basis.

cost of processing were compiled. Costs are defined to include labor, material (except wood), and the allotted share of indirect costs (plant overhead, fixed costs, and general and administrative costs) for each center. The volume of wood processed varies among process centers because of interplant transfers of partially finished veneers and because not all plywood grades require processing at each center, such as oil and edge sealing.

Data on the volume of each item sold and its selling value were also compiled. Cash discounts, selling commissions, and freight adjustments were deducted from reported selling values.

Cost Estimation

To simply generate unit cost estimates at each process center on the traditional 3/8-in. basis and then to apply these estimates to each category of panel would result in biased and inaccurate estimates. This is because not all costs are related to panel thickness. For example, panel trimming and sanding costs are the same for each panel regardless of size. Although costs are size related for many processes, the relationship is often not on a one-for-one basis. These considerations tend to bias cost estimates for a particular thickness when costs are derived using a 3/8-in. basis average cost figure. In general, cost estimates tend to be high for thick and low-grade panels (e.g., sheathing) and low for thin and high-grade panels (e.g., sanded) (Seale and Wagner 1988). To generate unit cost estimates comparable to the APA data, the following procedure was used.

Based on standard panel constructions (i.e., the number, thickness, and grade of plies used in each panel, App. A), the footage of panels sold was converted to equivalent footage of veneer (Table 2). Variable volumes of veneer are processed at each center due to interplant transfers; therefore, the estimated volume was adjusted by ratios of the volume of veneer processed at each center relative to the amount reported sold (Table 1).

For most process centers, resource requirement ratios were defined. These are the relative amounts of resources needed to process a unit of veneer of a given grade or thickness. These ratios were obtained from the APA cost report (APA 1983). The estimated volumes of veneer were weighted by these ratios, summed, and then divided into the cost. Multiplying the result by the resource requirement ratio for each grade or thickness yielded estimates of processing cost for that item. For specific process centers, costs were derived as described in the following sections.

Pondyard and Debarker

Pondyard and debarker costs were based directly on panel thickness before sanding. Unit costs using a 3/8-in. basis were first calculated. This cost was then converted for each panel thickness based on the ratio of the panel thickness to the standard 3/8-in. panel (e.g., the ratio for a 3/4-in. unsanded panel is 2, for a 3/4-in. sanded panel it is 2.167).

Green End and Drying

Green end and drying resource requirement ratios were defined as follows:

	Green end	Drying
1/10-in. veneer	1.00	1.00
1/8-in. veneer	1.10	1.20
3/16-in. veneer	1.45	1.90

The volume of veneer for each thickness was multiplied by its respective ratio. The adjusted veneer volumes were summed, and the total was divided into the cost incurred at the particular process center. The results were then multiplied again by the requirement ratios to obtain units costs for the three veneer thicknesses.

Veneer Preparation

Veneer preparation (edge gluing and veneer patching) costs are dependent on veneer grade. Resource requirement ratios are as follows:

Veneer grade	Ratio
A	1.00
B	1.25
C	0.34
C plugged	1.02
D	0.10

After adjustments by these ratios, reported process cost was divided by the total veneer volume. The result was multiplied again by these ratios to obtain unit costs for each veneer grade.

Layup and Press

Layup and press costs are partly determined by the number of plies used in a panel and partly by panel thickness. Resource requirement ratios by panel thickness are as follows:

Panel thickness (in.)	Ratio
1/4	1.00
3/8	1.02
1/2	1.94
5/8	1.96
3/4	2.00
7/8	2.78
8/8	2.83
9/8	2.90

Gluing

Gluing costs were distributed according to the number of gluelines in a panel. Panels 3/8 in. and thinner were assumed to contain one double glueline; panels 1/2, 5/8, and 3/4 in. thick were assumed to contain two double gluelines; panels 7/8 in. or thicker were assumed to contain three double gluelines. Panel volumes within these thickness ranges were multiplied by their respective glueline numbers and summed. The result was divided into total gluing costs. The resulting number was then multiplied by the glueline numbers to obtain gluing costs for each panel thickness.

Panel Trimming

All panels received an equal share of the trimming costs. That is, the resource requirement ratio was one for all panel thicknesses.

Panel Patching and Sanding

Panel patching and sanding costs depend on the grade of a panel. Resource requirement ratios are as follows:

Panel grade	Ratio
AA	1.00
AB	0.96
AC, AD	0.55
BB	0.83
BC, BD	0.50
CC, CDX	0.00
CDX PTS	0.33

Warehousing and Shipping

Warehousing and shipping costs are directly proportional to panel thickness, and the same procedure was used as in the pondyard and debarker section.

Selling

Selling costs were distributed to panel grades in proportion to their individual shares of total selling value.

Table 2–Veneer volume derived from panel production by thickness and grade

	Volume ($\times 10^6$ ft^2, surface measure)			
Veneer grade	1/10 in.	1/8 in.	3/16 in.	Total
A	73.4	509.7		583.1
B	32.7	336.3		369.1
C, C plugged	503.8	940.8	525.4	1,970.0
D	623.1	192.2	146.5	961.9
Total	1,233.1	1,979.1	672.0	3,884.1

Cost of each finished panel was determined by summing the costs derived for each panel thickness. This was based upon the number and grade of veneer plies used in the panel construction.

Comparability With APA Estimates

The APA (1983) cost report listed only direct costs by process center. Indirect and overhead costs were listed separately. The Forest Service data, however, combined both direct, indirect, and overhead costs. To compare the APA data to the Forest Service data, indirect and overhead costs were added to direct costs for each process center. The overhead costs were apportioned in relation to each process center's share of total direct costs. That is, if in the APA report drying costs were 20 percent of direct labor costs, then 20 percent of indirect and overhead costs were also added to drying. Table 3 contains the original and adjusted 1983 APA data for average costs and the 1988 average costs estimated in this study.

Results and Discussion

The data in Table 3 indicate that nonwood manufacturing costs, on the average, decreased by 3.7 percent between 1983 and 1988. This comparison, however, is influenced by changes in the grades of plywood panels produced. Comparing costs by individual plywood grades results in a more accurate estimate of underlying changes in manufacturing costs. The data in Table 4 indicate an average decrease of 14.6 percent for the four sanded grades and 8 percent for the three sheathing commodities. Appendix B contains detailed cost estimates for several plywood thicknesses and grades.

Spelter and Sleet (1989) estimated that nonwood manufacturing costs for a sheathing operation could be decreased by about 20 percent with the installation of modern equipment and techniques. These data suggest that plywood industry cost trends are heading in that direction.

The computer program used to derive the estimates contained in this report may be useful to mill owners for detailed cost accounting purposes. Information on the software program, VENVAL, and documentation may be obtained by writing to Henry Spelter, USDA Forest Service, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705-2398.

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Table 3–Average nonwood manufacturing costs for western sanded-plywood mills, 1983 and 1988

Process center	1983 APA data[a] (dollars/10^6 ft^2) Original	Adjusted	1988 estimate (dollars/10^6 ft^2)
Direct labor			
Green end	14.1	25.8	24.0
Drying	14.5	26.5	22.2
Veneer preparation	7.7	14.1	12.2
Layup and press	10.9	19.8	21.8
Panel trimming	0.8	1.4	1.3
Panel patching and sanding	5.3	9.7	9.4
Warehousing and selling	1.0	1.9	4.7
Total	54.3	99.4	95.7
Gluing	7.8	7.8	7.4
Total, direct costs	62.1	107.0	103.0
Indirect costs			
Plant overhead	29.8		
Fixed costs	8.5		
General and administrative	6.6		
Total, indirect costs	44.9		

[a]Overhead and fixed costs allocated to process centers according to each center's share of direct labor costs.

Table 4–Nonwood manufacturing cost comparisons for individual plywood grades

Grade	Panel thickness (in.)	Plywood costs (dollars/10^3 ft^2, surface measure) 1975	1981	1983	1988	1983-1988 change (percent)
AC, exterior glue	3/8	79.6	132.8	132.6	112.0	−15.5
AC, exterior glue	1/2	110.0	179.4	182.5	156.0	−14.5
AC, exterior glue	3/4	126.3	210.7	216.6	190.5	−12.0
BB O&ES glue	3/4	146.3	250.1	254.2	212.0	−16.6
CDX, 4-ply	1/2	69.9	117.1	118.6	109.5	−7.7
CDX, 5-ply	1/2	79.4	134.3	135.8	126.8	−7.8
CDX	3/4	97.2	163.6	169.6	155.2	−8.5

Appendix A
Panel Constructions

The panel constructions in Table A1 were used in converting panel volumes into equivalent veneer volumes. Although panel constructions vary from mill to mill, these are standard.

Table A1–Standard panel constructions

Type and thickness (in.)	Face (in.)	Back (in.)	Core (in.)	Center (in.)
Sanded				
1/4	1/10	1/10	1/10	
3/8	1/8	1/8	3/16	
1/2	1/10	1/10	2-1/8	1/8
5/8	1/8	1/8	2-1/8	3/16
3/4	1/8	1/8	2-3/16	3/16
Rough				
5/16	1/10	1/10	1/10	
3/8	1/8	1/8	1/8	
1/2	1/10	1/10	2-1/10	1/10
5/8	1/8	1/8	2-1/8	1/8
3/4	1/8	1/8	2-3/16	1/8

Appendix B
Cost Estimates for Key Plywood Thicknesses and Grades

Information for Tables B1–B6 was compiled from the 1988 Forest Service mill survey, the VENVAL program, and various issues of the APA annual cost reports.

Table B1–Industry average unit costs and selling values for Interior–AB plywood

	Amount (dollars/10^3 ft^2, surface measure)				
	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.
Costs by process					
Pondyard	2.5	3.6	4.8	5.7	6.7
Debarker	2.2	3.2	4.1	4.9	5.9
Green end	16.1	19.6	28.4	31.4	35.1
Drying	17.6	25.2	32.8	39.2	47.4
Veneer preparation	19.8	19.8	21.4	21.4	21.4
Layup and press	18.9	19.3	36.8	37.1	37.9
Trimming	1.9	1.9	1.9	1.9	1.9
Panel patching and sanding	24.4	24.4	24.4	24.4	24.4
Warehousing	2.3	3.4	4.4	5.3	6.3
Selling	1.6	1.8	2.2	2.7	3.1
Gluing	6.4	6.4	12.7	12.7	12.7
Total	113.7	128.5	174.1	187.0	203.0
Selling values	239.4	253.4	309.2	366.7	411.6
Costs by year					
1988 - Forest Service	113.7	128.5	174.1	187.0	203.0
1983 - APA	152.2	170.6	215.5	229.7	249.3
1981 - APA	152.0	169.0	213.3	226.0	244.5
1975 - APA	93.2	102.7	131.4	138.0	148.0

Table B2–Industry average unit costs and selling values for Interior–AD plywood

	Amount (dollars/10^3 ft^2, surface measure)				
	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.
Costs by process					
Pondyard	2.5	3.6	4.8	5.7	6.7
Debarker	2.2	3.2	4.1	4.9	5.9
Green end	16.1	19.6	28.4	31.4	35.1
Drying	17.6	25.2	32.8	39.2	47.4
Veneer preparation	9.8	9.8	11.5	11.5	11.5
Layup and press	18.9	19.3	36.8	37.1	37.9
Trimming	1.9	1.9	1.9	1.9	1.9
Panel patching and sanding	13.9	13.9	13.9	13.9	13.9
Warehousing	2.3	3.4	4.4	5.3	6.3
Selling	1.6	1.8	2.2	2.7	3.1
Gluing	6.4	6.4	12.7	12.7	12.7
Total	93.2	108.0	153.6	166.5	182.5
Selling values	173.0	193.8	247.2	303.5	347.8
Costs by year					
1988 - Forest Service	93.2	108.0	153.6	166.5	182.5
1983 - APA	114.1	132.3	177.2	191.6	211.4
1981 - APA	113.1	130.0	174.5	187.0	206.0
1975 - APA	70.1	79.5	108.3	114.9	124.9

Table B3–Industry average unit costs and selling values for Exterior–AB plywood

	Amount (dollars/10^3 ft^2, surface measure)				
	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.
Costs by process					
Pond yard	2.5	3.6	4.8	5.7	6.7
Debarker	2.2	3.2	4.1	4.9	5.9
Green end	16.1	19.6	28.4	31.4	35.1
Drying	17.6	25.2	32.8	39.2	47.4
Veneer preparation	21.2	21.2	26.8	26.8	26.8
Layup and press	18.9	19.3	36.8	37.1	37.9
Trimming	1.9	1.9	1.9	1.9	1.9
Panel patching and sanding	24.4	24.4	24.4	24.4	24.4
Warehousing	2.3	3.4	4.4	5.3	6.3
Selling	2.3	2.4	2.9	3.5	4.0
Gluing	6.4	6.4	12.7	12.7	12.7
Total	115.8	130.6	180.1	193.0	209.1
Selling values	249.0	265.1	322.1	384.3	439.0
Costs by year					
1988 - Forest Service	115.8	130.6	180.1	193.0	209.1
1983 - APA	142.6	171.0	216.2	230.6	250.7
1981 - APA	152.4	169.3	213.9	226.5	245.3
1975 - APA	93.5	103.2	132.0	138.8	148.7

Table B4–Industry average unit costs and selling values for Exterior–AC plywood

	Amount (dollars/10^3 ft^2, surface measure)				
	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.
Costs by process					
Pondyard	2.5	3.6	4.8	5.7	6.7
Debarker	2.2	3.2	4.1	4.9	5.9
Green end	16.1	19.6	28.4	31.4	35.1
Drying	17.6	25.2	32.8	39.2	47.4
Veneer preparation	13.7	13.7	19.3	19.3	19.3
Layup and press	18.9	19.3	36.8	37.1	37.9
Trimming	1.9	1.9	1.9	1.9	1.9
Panel patching and sanding	13.9	13.9	13.9	13.9	13.9
Warehousing	2.3	3.4	4.4	5.3	6.3
Selling	1.6	1.8	2.4	2.9	3.4
Gluing	6.4	6.4	12.7	12.7	12.7
Total	97.1	112.0	161.5	174.3	190.5
Selling values	181.6	203.1	262.3	322.3	374.6
Costs by year					
1988 - Forest Service	97.1	112.0	161.5	174.3	190.5
1983 - APA	118.9	136.1	182.5	196.8	216.5
1981 - APA	117.8	134.7	179.4	192.1	210.9
1975 - APA	70.1	79.5	108.2	114.9	125.0

Table B5–Industry average unit costs and selling values for Exterior–BB O&ES plywood

	Amount (dollars/10^3 ft^2, surface measure)	
	5/8 in.	3/4 in.
Costs by process		
Pond yard	5.7	6.7
Debarker	4.9	5.9
Green end	31.4	35.1
Drying	39.2	47.4
Veneer preparation	28.8	28.8
Layup and press	37.1	37.9
Trimming	1.9	1.9
Panel patching and sanding	20.9	20.9
Warehousing	5.3	6.3
Selling	3.2	3.7
Gluing	12.7	12.7
Oil and edge seal	4.7	4.7
Total	195.8	212.0
Selling values	338.5	403.8
Costs by year		
1988 - Forest Service	195.8	212.0
1983 - APA	234.1	254.2
1981 - APA	231.1	250.0
1975 - APA	140.0	150.0

Table B6–Industry average unit costs and selling values for 5-ply Exterior–CDX plywood

	Amount (dollars/10^3 ft^2, surface measure)				
	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.
Costs by process					
Pondyard	2.5	3.1	4.1	5.2	6.2
Debarker	2.2	2.7	3.6	4.5	5.4
Green end	16.1	17.7	26.8	29.5	33.2
Drying	17.6	21.1	29.3	35.1	43.3
Veneer preparation	4.3	4.3	6.0	6.0	6.0
Layup and press	18.9	19.3	36.8	37.1	37.9
Trimming	1.9	1.9	1.9	1.9	1.9
Panel patching and sanding	0.0	0.0	0.0	0.0	0.0
Warehousing	2.3	2.9	3.9	4.8	5.8
Selling	1.1	1.4	1.7	2.2	2.6
Gluing	6.4	6.4	12.7	12.7	12.7
Total	73.3	80.8	126.9	139.2	155.2
Selling values	120.1	149.8	192.4	242.5	286.0
Costs by year					
1988 - Forest Service	73.3	80.8	126.9	139.2	155.2
1983 - APA	81.9	90.6	137.1	151.2	169.6
1981 - APA	79.7	86.8	134.4	145.9	163.7
1975 - APA	64.4	68.6	98.53	105.0	114.0

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