

## AN ABSTRACT OF THE THESIS OF

Janet R. Ross for the degree of Master of Science in Forest Resources on July 6, 1995. Title: Value, Volume, and Jobs: A Comprehensive Assessment of Wood Fiber and Residue Utilization Within Oregon: 1992

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Oregon's forest product industry continues to be the nation's number one producer of wood products. The forest products industry contributes significantly to Oregon's economy. Changes in timber supply, land use policy, technology, and product demand create significant impacts on the region. The activities of the wood products industry translate into jobs, payroll, taxes, and the purchase of services and materials from other industries. In order to trace the contribution of the wood products industry to the state of Oregon's economy, a thorough understanding of how wood is utilized at all subsequent stages of processing is necessary. This study provides an in-depth look at the forest products industry by estimating the volume of wood, number of jobs, and value added of product shipments at each stage of processing, from harvest to final product.

The forest products industry as defined in this study includes six primary wood processing industries: sawmills; veneer and plywood mills; pulp and board mills; shake and shingle mills; pole, post & piling mills; and log export firms. Seven secondary and/or residue converting industries are included: structural members, which produce engineered wood products such as laminated veneer, glu-lam beams, and I-joist; millwork; furniture; materials handling, which includes pallets, dunnage and other products used in shipping; reconstituted

wood products, such as particle and hard board; converted paper and board products; and miscellaneous wood products. Forestry services and regeneration, logging operations, and hauling are also included to the extent possible.

The results of this study indicate the forest products industry in Oregon supported in excess of 80,000 jobs and provided value added in manufacture of more than 5.2 billion dollars in 1992. The estimated harvest volume in 1992 was 1,409.4 million cubic feet and 1,547.1 million cubic feet of logs were consumed in Oregon primary wood products industries. The employment numbers in this study are not directly comparable to other studies because the definition of "wood products industries" may be broader than in other reports. Using the traditional definitions of SIC 24 (lumber and wood products) and SIC 26, (paper and allied products) 63,000 people were employed in wood products industries in 1992.

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Value, Volume, and Jobs;  
A Comprehensive Assessment of Wood Fiber and Residue Utilization Within  
Oregon:  
1992

by

Janet R. Ross

A THESIS

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## DEDICATION

For my Grandmother, Gertrude Ross,  
Although she is no longer here, I have felt the strength of her presence at  
every turning point in my life.  
Her love of all living things and endless pursuit to further her own  
education left an indelible impression on my own life.  
Shortly before her death she said to me that she knew I could accomplish  
anything I set my mind to, I just had to believe in myself.  
I'm happy, and somewhat surprised to say, that once again,  
she was right,

And for my Grandfather, Irvin Ross,  
who has always loved all of us for who we are,  
whose sense of humor always brings a smile to my face,  
and who is simply the dearest man I've ever known.  
I Love you Grandpa!

# **Value, Volume, and Jobs; A Comprehensive Assessment of Wood Fiber and Residue Utilization Within Oregon: 1992**

## **INTRODUCTION**

### **Background**

It is difficult to trace the contribution of the wood products industry to Oregon's economy or the sub-regions within the state without a thorough understanding of the utilization of wood from the stump through all subsequent stages of processing, including residue utilization. To date, most studies of the wood products industry have used econometrically derived linkages and/or accounting expenditure relationships, such as input/output models, to address vertical and horizontal linkages among stages of processing. These procedures have often addressed the linkages in rather indirect ways and made it difficult to ascertain what impacts alternative regional sources of wood might have on the operation of the region's industry. In addition, many studies limit wood products industries to those that fall within Standard Industrial Classification (SIC) 24, lumber and wood products and therefore under estimate employment and impacts related to reductions in timber supply.

Oregon's wood product industry continues to be the nation's number one producer of wood products. The wood products industry contributes significantly to Oregon's economy, not only in jobs and dollars, but to the diversity of the Oregon economy, an important factor in economic terms because of the cushion it provides in times of recession. The activities of the wood products industry translate into jobs, payroll, taxes, and the purchase of services and materials from other industries. In order to trace the contribution of the wood products

industry to the state of Oregon's economy, and to assess the impacts of restrictions in wood supply, a thorough understanding of how wood is utilized at all subsequent stages of processing is necessary. Changes in timber supply, land use policy, technology, and product demand create significant impacts on the region.

### **Objectives of the Study**

Managers and policy makers interested in economic stability or economic development are often interested in estimating the impact of changes or proposed changes in the economy. Such changes may result from policies of public agencies or marketing strategies of private businesses. Local governments are interested in forecasting changes in business activity, employment, population, and public service demands. Decision makers within the industry are also in need of information on how the resource is being used and how the industry is changing. This study provides an in depth look at the forest products industry within the state of Oregon in 1992. The specific objectives of this study are to:

- 1) determine the general flow of wood in Oregon from harvest to final products;
- 2) determine the economic sectors that are involved in harvesting or processing wood products in Oregon;
- 3) determine the volume of wood utilized in each sector, including bark and residue;
- 4) identify the number of jobs in each sector;

- 5) assess the value added in manufacture of product shipments for each sector.

### **Scope of the study**

The forest products industry as defined in this study includes six primary wood processing industries: sawmills; veneer and plywood mills; pulp and board mills; shake and shingle mills; pole, post & piling mills; and log exporters. In addition, seven secondary and/or residue converting industry groupings are included: structural members, which include engineered wood products such as laminated veneer, glu-lam beams, and I-joist; millwork, which in this study is grouped with kitchen cabinets; furniture manufacturing; materials handling, which includes pallets, dunnage and other products used in shipping; reconstituted wood products, such as particle and hard board; converted paper and board products; and miscellaneous wood products, which includes such diverse products as hammer handles and chair seats. Forestry services, timber tracts, and logging operations are also included. Hauling of logs and other wood products and exporting are also considered important sectors and were included to the extent the data allowed. The region identified in this study is the state of Oregon and data is based on 1992.

## LITERATURE REVIEW

Many factors affect the wood products industry and its contribution and importance in the Oregon economy. Currently, the state of Oregon has 29.5 million acres of forest land. Of that, 19.4 million acres (66%) are classified as timberland (land capable of producing commercial timber). Fifty-one percent of the timberland is managed by the Forest Service and the Bureau of Land Management. Of the remaining timberland, 29 percent is managed by wood products industries, another 14 percent is held by other private owners, and 6 percent is managed by state and local governments (Beuter 1995).

The controversy over management of these lands has been debated for several decades and continues today. Harvest levels have been drifting downward in the last twenty years with the exception of the late 1980's and continue to affect Oregon's economy. Public forest management policy changes (which affect timber supply), changing market conditions (from demand and growth in other industries), and long-term and extensive changes in wood products technology all contribute to shifting conditions in Oregon's economy and the importance of the wood products industries within it (Conway et al. 1994).

In this review of literature, studies have been grouped together as follows: a) those identifying factors affecting the wood products industries beginning with timber supply, demand, and technology; b) those describing the contribution of the wood products industries and the impacts of reduced harvest levels, as well as discrepancies in the definition of wood products industries; and c) those discussing difficulties in measurement and comparison.

## Oregon Timber Supply

Harvest levels in the Pacific Northwest have been declining for the past several years. In 1991, Judge William Dwyer of the U.S. District Court in Seattle, placed an injunction on federal timber sales, effectively halting harvest from federal lands. On April 2, 1993, in an attempt to resolve the spiraling conflict between concern for the environment and the equally distressing regional fear of local economic decline, President Clinton convened the Forest Conference in Portland. A panel of biologists, economists, and social scientists, called the Forest Ecosystem Management Team (FEMAT) were appointed to assess these problems and outline feasible options. The FEMAT recommendations became part of the "Clinton Northwest Forest Plan," which on June 6, 1994, was judged to be in compliance with federal law, and subsequently warranted lifting of the 1991 injunction (Beuter 1995). The effect of the Clinton Northwest Forest Plan is to reduce harvests on federal forests from their 1980 levels.

In addition to concerns about federal timber supply, increasing regulation on private lands (e.g., recent revisions of the Oregon Forests Practices Act), management decisions regarding salmon, and forest health issues on eastside Oregon forests, have significantly reduced, and/or leave in question, the volume of timber available for harvest now and in the future. In 'Legacy and Promise; Oregon's Forests and Wood Products Industry' (1995), Beuter suggests that if the Clinton plan is fully implemented, west side federal forests will see at least a 75 percent reduction in harvest from the sustainable volume indicated in 'Timber for Oregon's Tomorrow; The 1989 Update' (Sessions et al., 1991). Beuter also states that he would not be surprised to see a 50 percent reduction in east side Oregon federal harvests in response to endangered salmon. Current harvest

reductions create considerable impacts on the wood products industry and the economy of Oregon as a whole.

### **Demand For Wood Products**

Lumber prices are a result of market supply and demand. Oregon wholesale lumber prices have increased 63% from \$292.70 per mbf to \$467.60 per mbf in nominal price between 1990 and 1993, while production continued to decline from a high of 8.9 billion board feet in 1987, 7.5 billion board feet in 1990, and to 5.5 billion board feet in 1993. Although production was down, Oregon continued to be the leading lumber producing state in the U.S. in 1993, accounting for 32.1 percent of total softwood production (WWPA1994).

The 1993 RPA Timber Assessment Update (Haynes et al., 1993) also analyzes the timber resource situation in order to provide indications of the future costs and availability of timber products to meet the nation's demands. The assessment details trends in supply and demand. It predicts U.S. lumber demand will rise to near peak levels by 1995 and remain at that level through 2040. Projections for regional production show an expanding national industry but lumber production will continue to shift from the Pacific Coast to the Southern regions in response to rising stumpage prices, due mainly to restricted supply in the western region. There may also be substantial effects from changes in world markets.

### **Technology in Oregon Wood Products Industries**

Improved technology in the wood products industries, as well as timber supply and demand, affect employment. The timber economy declined sharply

in the early 1980's when the worst recession since 1930 struck Oregon. Firms who survived the recession invested in cost-cutting and efficiency measures enabling them to employ fewer, more productive workers (Conway 1994). Employment in the solid wood products industries declined from an average of 134,000 to 108,000 persons in Oregon and Washington during the period between 1977-1979 to 1987-1989. During the same time harvest levels were 5% higher. Due to technological change, labor was displaced at a rate of about 2.6% per year for that 10 year period (Greber 1993). Greber reports that "[t]he costs and benefits of technological change in the timber industries are among the most widely misunderstood and misrepresented factors in the current debate over natural resource management and the fate of timber-dependent communities in the Pacific Northwest." Greber lists four components of technological change. These are changes that minimize labor inputs, such as automated production, changes that minimize raw material inputs such as using thinner saw kerfs or composite products, changes that save on capital inputs such as computerized product inventory, and changes that involve enhancing a product to increase its value. Of these, technology which improves raw material recovery enabling the firm to increase output, may actually increase the number of workers in a given industry.

### **Contribution of Wood Products Industry and Impacts of Reduced Harvest**

There have been many studies dealing with impacts covering different time periods and with varying definitions of wood products industries making it difficult to compare reports, but it is clear that wood products industries contribute significantly to the economic structure of Oregon. In recent years, total employment in the state grew and the economy became more diversified in

manufacturing as new industries entered the state. Some argue that the declining percentage of wood products jobs relative to state employment indicates that wood products are becoming of minor importance in Oregon's economy. Beuter (1995) suggests that employment is a poor representation of the industry's importance. He reports that annual pay in the wood products industry averaged \$30,000 in 1992 compared to a statewide average of about \$23,500 for all employment sectors and that wood products payroll was 7 percent of the state's total payroll. Beuter suggests that in 1990 employment derived from activity produced by the primary wood products sector accounted for approximately 37 percent of state employment. He bases this on the fact that primary wood products were 4.18 percent of Oregon employment in 1990 yet accounted for only .57 percent of U.S. employment. According to Beuter, the higher percentage for Oregon suggests that the wood products industry is part of the state's economic base. The difference between the state and the nation, 3.61 percent, is a relative index of how much "excess" employment Oregon has in the wood products industry. Beuter reports the sum of analogous indices for all basic industry sectors in Oregon was 9.75 percent. Thus, the relative importance of primary wood products among all of Oregon's basic industrial sectors is estimated by the percentage determined from the ratio  $3.61/9.75$ , or 37 percent (1995). This ratio includes direct, indirect, and induced jobs throughout Oregon's economy. Beuter admits a margin of error associated with this estimate because it is not based on intensive trade flow analysis.

In 'Timber For Oregon's Tomorrow: The 1989 Update' (Sessions 1991) reports that in 1988, Western Oregon timber industry wage and salary

employment totaled approximately 63,000<sup>1</sup> people and accounted for \$1.4 billion in payrolls. In addition, an average of \$215.5 million was contributed annually to local governments in Western Oregon between 1983 and 1987. However, reductions in timber supply on federal forests will have major impacts. Spriggs (1992) reports that average annual payments from the years 1986-1990 of \$141.3 million would drop again to \$121.3 million in the 1990's if based on harvest reductions suggested by the ISC Conservation committee's alternative B, which proposed to reduce harvest levels from 3.1 billion board feet to 1.9 billion board feet (bf) on US Forest Service (USFS) lands alone. In 1992 actual harvest levels were all ready down to 1.4 billion bf (Warren, 1993).

Declining harvest levels will change the importance of timber in Oregon's economy. The Sessions et al., report projected total wage and salary employment in the timber industry would drop from 6.9 percent of total statewide employment in 1988 to 5.3 percent in 1995 and from 36 to 31 percent of employment in manufacturing industries (Sessions, et.al., 1991). Based on the definition of the timber industry assumed in the Sessions, et. al., report, by 1992, industry employment had already dropped to 5 percent of statewide employment. In SIC 24, lumber and wood products and SIC 26, paper and allied products, there were 63.3 thousand employees, while statewide employment totaled 1,257 thousand (Oregon Employment Division 1993).

A more recent paper, 'The Oregon Wood Products Industry Employment Trends By Sector: 1988 - 1992' (Spriggs, 1993), is an update to the 1990 report 'Estimation of Economic Multipliers for the Oregon Wood Products Industry.'

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<sup>1</sup>'Timber industry' in the 1989 Update is defined as logging, sawmilling, plywood and veneer preparation, pulp and paper processing and the manufacture of other wood products, i.e., only those that fall under Standard Industrial Code (SIC) classification 24 lumber and wood products and SIC 26, pulp and paper; does not include furniture, hauling, forestry services or jobs related to export.



The purpose of the report was to provide data on employment and examine employment effect claims in recently issued forest management plans and economic impact statements. Spriggs discusses how insufficient or skewed information can lead to erroneous conclusions about a plan's effect on employment. His paper provides figures on employment from 1988 to 1989 with preliminary information on 1992, some of which were based on recent averages. Spriggs estimated total 1992 wood products industries employment at 75,492, down from 89,139 in 1988. His definition included lumber and wood products, SIC 24, including mobile homes and prefab buildings, forestry timber tracts, SIC 08, and paper and allied products SIC 26. For this study he did not include hauling or selected wood furniture industries, as was the case in the previous study, where he indicated that direct industry employment may be as high as 110,000 workers in 1988 with inclusion of those industries.

Impacts of restricted timber supply are not limited to jobs but entire businesses. In Oregon, the number of sawmills declined from 243 in 1976 to 165 in 1988, while veneer and plywood mills declined from 132 in 1976 to 87 in 1988 (Howard and Ward 1988, 1991). The Oregon Employment Department's 'Labor Trends' (1994) also reports closures and cutbacks affecting lumber and wood products facilities. Between 1989 and November 1994 more than 30 mills were forced into permanent closure, most indicating lack of logs as the primary reason. These declines were most likely in response to both declining harvests and increased efficiency.

Secondary wood products are also an important component of Oregon's timber economy and there is increasing interest in their role in regional economies. Kingslein and Greber (1993) examine characteristics and growth trends of secondary wood products manufacturing (wood remanufacturing) employment, value added, value of shipments, and wood use in 20 sectors of

be comprehensively analyzed (Northwest Pulp and Paper Association, October 1993).

The pressure to preserve Oregon's forests and policy changes that limit the supply of timber have also directed attention to the log export trade as a means to keep jobs in Oregon. Overseas log exporting firms are an important segment of the wood products industry. Oregon State University Extension produced a report titled 'Log Exports from Oregon' (1991) which states that log export firms employ approximately 1.3 persons per million board feet but at higher wages than milling jobs. In 1988, according to the OSU extension report, enough logs were exported out of Oregon to run about 20 mills and employ 2000 people. This report states that about 2,500 people were employed in log export activities during the same time period. This suggestion does not consider the multiplier effects of other services and materials purchased by either industry. (For more on multiplier effects see Radtke et.al., 1987). Overseas exporters of lumber and other wood products are also significant employers. In 1993, 54.4% of all U.S. lumber exports were shipped through West Coast ports (WWPA 1994).

### **Defining the Wood Products Industry and Problems in Comparing Data**

Several factors make it difficult to compare employment figures between wood products industries, as well as impacts from harvest restrictions on the wood products industries. Spriggs (1990,1993) reports that proposed plans frequently underestimate social and economic impacts of declining harvests in part by limiting the definition of the forest products industry to those which fall under Standard Industrial Code classification 24, lumber and wood products. SIC 26, paper and allied products, may be included in some reports. SIC 08,

forestry, and several four digit codes of SIC 25, furniture, should also be included according to Spriggs. Other industries such as firms that haul logs, lumber, and wood products are classified in SIC 42, independent trucking firms which is an all inclusive transportation classification. Because those firms that are tied to wood products are difficult to separate, they may frequently be excluded. Firms that export logs are also closely tied with the wood products industries and should possibly be included.

Spriggs discusses problems of groupings within classifications, as well as the inherent difficulty of SIC codes underestimating total industry activity due to the nature of the groupings. The U. S. Bureau of Census estimates that slightly more than 90 percent of the SIC 24 products shipped in 1987 actually were produced in SIC 24 firms. According to Spriggs, this means that nearly 10 percent of the lumber and wood products activity is attributable to firms classified in other SIC codes and therefore SIC 24 information understates data on the type of activities covered in the lumber and wood products category (Spriggs 1990). It should be noted that firms in SIC 24 may also be engaging in activities that may be more accurately classified in other SIC codes. For instance, mobile home manufacturing, SIC (2451) is classified as a lumber and wood products industry, but the amount of wood input in relation to other raw materials is small, making it less directly dependent on timber supply. In this study, mobile homes and prefab buildings were not included in total wood products employment and value added summaries.

Many reports compare employment to harvest volumes. This can be dangerous, since harvest volumes are not necessarily processed in the same year and more importantly, the amount of overrun a mill may produce changes with technology advances. Assessment of labor use is further complicated by the use of greater proportions of smaller trees resulting from tighter harvest

restrictions. Greber (1993) reports that tree measurement standards produce board foot estimates that rarely reflect accurate lumber yields. The measure used in the Pacific Northwest (i.e., Scribner log rule) increases in error for smaller diameter logs. Greber indicates that comparing a 16 foot log with an 8 inch diameter inside bark, (d.i.b.) at the small end, to a log 20 inches in d.i.b at the small end will show nearly 21 percent more lumber per mbf in the first log, when logs are measured in Scribner log rule. A million board feet of timber harvested in 1995 may generate greater mill output than the mmbf of timber harvested in 1985, especially in light of the decreasing size in log diameters. The sorts of lumber produced, will most probably also be significantly different (Greber 1993). Comparing ratios of harvest volume to employment over time can be very misleading.

### **Volume Measurement Problems and Comparison of Inputs and Outputs**

One of the difficulties in preparing a report of this detail on wood products is the differences in the way wood volume is reported in different sectors. For instance, in the Pacific Northwest, most statistics reporting raw log volume use Scribner log rule in thousand board feet (mbf), which is a rough estimate of the lumber a mill can produce from the log. The true volume is reduced for defect and other factors such as trim allowance. Scribner log rule also assumes a saw kerf of one quarter inch thick and that lumber widths produced are in even inch thickness. In actuality, the size of board produced may be quite different than the nominal size. A two by four stud is 1-5/8 by 3-5/8 inches rough green size and in addition, more efficient mills use saw kerfs that are considerably thinner than 1/4 inch. This results in what is known in the industry as 'overrun'; the amount of lumber over the amount predicted by Scribner log rule. The amount

of over and underrun varies with the size and species of timber. As a result, every combination of board foot rule and a cubic foot rule may result in a different yield (Briggs 1994). Greber (1993) states that log measurements are only approximations of actual lumber yields. As fiber recovery technologies change, the standard log rules become less accurate. The average yield of lumber from an mbf of logs in the Pacific Northwest increased from 1,355 bf in 1970 to 1,545 bf in 1979 (Adams et al. 1988). According to Greber, more emphasis was placed on labor saving strategies from 1980 - 1985 and mill recovery remained relatively stable during this period. (Greber 1993).

In addition, statistics reporting lumber yield also use board foot measures which assume nominal sizes of lumber produced. Converting volume straight to cubic feet will result in over or underestimation of volume output depending on product size, degree of processing, and wood species used. For example, a board foot is defined as a board having nominal dimensions of 1" by 12" by 12". A cubic foot would be represented by 12 board feet. The actual dimension produced is likely to have a much higher board foot to cubic foot ratio. The U.S. timber assessment uses a U.S. average of 16.67 board feet per cubic feet for softwood and 12 board feet per cubic feet for hardwoods.

'Forest Products Measurements and Conversion Factors with Special Emphasis on the U.S. Pacific Northwest' (Briggs 1994) provides more information on basic wood properties, log, lumber, and residue measurements, and conversion factors.

## METHODOLOGY & DATA SOURCES

The time frame for this study was initially based on the year 1992 because both the PNW Research Station and the Bureau of Census were scheduled to release respectively, the 1992 mill survey and the 1992 Census of Manufactures geographic area surveys, both of which are reported at approximately five year intervals.

### Data Sources

Data for this report have been obtained directly by conducting personal interviews and/or from published and unpublished data. Much of the published literature relevant to this project are data reports on various sectors of the wood products industry, including the following:

- Howard and Ward (1991) compiled a report on their findings of a survey of all primary forest products industries in Oregon in 1988. This mill survey, titled 'Oregon's Forest Products Industry: 1988', includes lumber, veneer and plywood, pulp and board, shake and shingle, exports, and post, poles, and pilings. The Howard and Ward study also reports the number of logs consumed by mills, and production and utilization of residues. The Forest Service has conducted and published these surveys approximately every five years since 1976. In addition, a draft version of the 1992 survey has just been completed, although it had a low response rate.

- Warren (1993) publishes a quarterly report titled 'Production, Prices, Employment, and Trade in Northwest Forest Industries'. This publication provides current information on lumber and plywood production, prices, and employment in forest industries. It also reports international trade in logs,

lumber, and plywood; volume and average prices of stumpage sold by public agencies; and other related subjects.

-Schallau, (1991) reports annual harvest statistics from private, public and industrial timber lands.

-Lumber shipments, state by state, are gathered by the Western Wood Products Association (WWPA). The WWPA publishes the 'Statistical Yearbook of the Western Lumber Industry', as well as, 'Origin to Destination Reports of Western U.S. Softwood Lumber Shipments by State and Mode of Transportation'. The first provides statistical details about the lumber industry in the 12 state western lumber region. It provides basic facts from annual mill surveys. Origin to destination reports provide shipment data by state and mode of transportation.

-The American Plywood Association produces quarterly reports titled 'Geographical Analysis of Plywood Shipments' for each region. This firm keeps track of softwood plywood and veneer produced, as well as engineered wood products. Engineered wood products data have been collected since 1992 but remain unpublished.

-Pulp and allied paper products data are collected by the National Forest and Paper Association, although 1992 information for this report was gathered by personal communication.

-Information on jobs and payroll are published in various reports by the Oregon Employment Division, Department of Human Resources, Research and Statistics division.

-Value added, employment, number of establishments, cost of materials, and new capital expenditures by industry and state are reported in various Bureau of Census reports.

-'Forest Statistics of the United States; 1987' (Waddell et al., 1989) provides information on area, volume, removals, and other timber product outputs such as bark, wood residue, logging residue, and other removals by type, species, region, and type of use.

-'Forest Products Measurements and Conversion Factors with Special Emphasis on the U.S. Pacific Northwest' (Briggs 1994) provides information on basic wood properties, log, lumber, and residue measurement, and conversion factors.

Collection of actual input and output data from each sector is difficult. As mentioned previously, this study was initiated on the assumption that the next in a series of mill surveys conducted at five year intervals by the Forest Service would be completed for 1992. Unfortunately, this was not an accurate assumption. The Forest Service had a poor response rate to the current survey, yielding data that is non-representative of Oregon as a whole. To counter this, adjustments were made based on both the 1988 mill survey and the 1992 unpublished data to estimate the volume of logs imported to Oregon, logs exported out of Oregon, and logs shipped to each of the primary sectors.

Ideally, a study of this nature would be conducted with a current and complete mill survey. In addition, a statistical sampling in gross cubic foot measure of logs harvested would provide more accurate input volumes. Import logs are also difficult to quantify. At this time the only source for this information is also the Forest Service mill surveys which ask operators to report log origins. The above mentioned problems may cause discrepancies in the raw material input estimates.

Outputs from most primary and secondary mills are based on actual reports generated by associations such as the Western Wood Products Association and American Plywood Association. Volume estimates of outputs

are considered to have a high degree of accuracy, but conversions from the reported measure into cubic feet may cause discrepancies in some instances due to lack of a standard conversion or reporting method.

### **Flow of Wood Products Through Oregon's Economy**

Understanding the flow of wood products from regeneration to the final consumer is important in describing the impacts of wood products industries to the economy of Oregon. Flow charts (fig. 1 and 2 in the results section) depict the general flow of wood fiber and the volume of wood, jobs, and valued added in manufacture for each sector. The forestry sector 'grows' the timber which is harvested in logging operations. This harvest plus the logs imported from outside Oregon's borders are the logs consumed in primary converting industries. Import and export logs in this paper refer only to domestic logs hauled across state borders, possibly to or from Washington, Idaho, California, or other states. Import logs are then processed in Oregon. It is also important to note that even logs that are exported go through some degree of processing before they are shipped. Jobs related to domestic import and export are included in individual mill totals. International import and export are referred to as overseas export or import in this report and include all goods moved through Oregon ports. Volume reported in overseas export may not necessarily be produced only in Oregon but a significant number of Oregon jobs are a direct result of overseas log export, though they may be somewhat less dependent on Oregon harvest levels.

A percentage of total log consumption is used in each of the primary converting sectors including pulp mills and export. Additionally, a certain amount of residue and firewood are produced during harvest. From the primary

converting sectors, shake, shingle, split rails, poles, posts, and piling products are shipped to the final consumer. A portion of plywood, veneer, and lumber production also goes to outlets that sell to the final consumer. The remainder of these products are shipped to the secondary converting sectors and remanufactured into products such as structural members, millwork, furniture, and materials handling products.

Pulp mills use residue such as chips produced in both the primary and secondary converting sectors, in addition to whole pulpwood logs and recovered paper to produce the pulp used in board and paper mills. Board and paper mills, in turn, produce the fiber stock used in the converted paper and board mills whose product is consumed by final demand in the form of napkins, writing paper, boxes, and other paper products.

Reconstituted wood products use mill residue and some board and paper products to produce their final products. Both primary and secondary converting firms produce as a by-product, residues and bark, some of which are used as mentioned in the above industries but may also be utilized for fuel to produce the energy that drives production in primary and secondary mills.

## **Employment**

All employment figures, except where noted, were derived directly from the '1992 Oregon Covered Employment and Payrolls by Industry and County,' Oregon Department of Human Resources. Figures for some industries, such as wood products hauling, are difficult to identify. This particular industry is imbedded within trucking and transportation, SIC 42, and includes hauling of other products. Some hauling is also included in SIC 2411 logging operations. For instance, if the firm hauls logs, but primarily harvests timber, both hauling jobs and logging employment figures would be included in logging operations. A direct estimate for this sector (wood products transportation) was not available for 1992, but a study published by Spriggs (1990) estimated wood products hauling jobs at 15,000 in 1988. To arrive his figure a survey of trucking firms was conducted to establish employment in this industry.

Overseas export jobs related to wood products were also not directly available. An estimate of jobs related specifically to overseas export of logs was derived based on a study titled 'Log Exports from Oregon' (OSU Extension, 1991).

## **Value Added**

Value added by manufacture is a measure of manufacturing activity used in the Census of Manufactures and other industry reports. Value added is derived by subtracting costs of materials, containers, fuel, purchased electricity, and contract work from the value of shipments for products produced, plus receipt for services rendered. The result of this calculation then is adjusted by the addition of value added by merchandising operations (that is, the difference between the sales value and cost of merchandise sold without further

manufacturing, processing, or assembly) plus the net change in finished goods and work-in-process inventories between the beginning and end of the year (Census of Manufacturers Preliminary Industry Series, 1992). Simply put, value added in manufacturing is the difference between the value of products produced and the cost of materials used to produce them. A firm with a higher value added in manufacture indicates that more money is likely being spent locally on labor and other services, thereby having a greater impact on local economies. Value added is considered to be the best value measure available for comparing the relative economic importance of manufacturing among industries and geographic areas (Census of Manufacturers, Preliminary Industry Series, 1992).

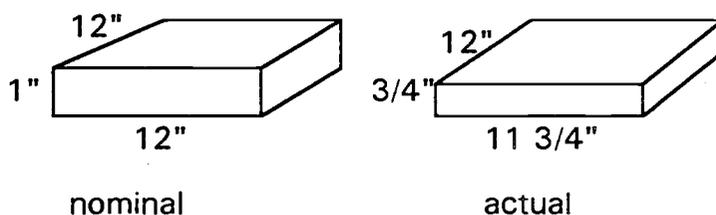
The U.S. Department of Commerce, Bureau of Census publishes a Census of Manufactures Geographic Area Series every five years which reports summary statistics by state. At the time of this study the 1992 report was not yet available for Oregon. To determine a reasonable estimate of value added for 1992, a ratio between value added and payroll reported in the 1987 Geographic Area Series was applied to the 1992 payroll reported in 'Oregon Covered Employment and Payroll' published by the Oregon Employment Division, Department of Human Resources. <sup>2</sup>

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<sup>2</sup>In some cases, a particular SIC code grouping may not have been available directly, due to disclosure. These are addressed separately as each sector is detailed in Appendix B.

## Volume

Volumes were determined from many different sources and from many different scales. All volumes reported in this paper were converted to cubic feet, although tables reporting board feet estimates of logs and lumber may be found in the results section of this paper. Initial volume of raw logs are reported by industry in Scribner log rule. This log rule is a net scale, does not include residue or defect, and is measured diameter inside bark (dib). This rule regards the volume of lumber produced as the true dimension of a piece as stated in commerce. For example, a piece of lumber sold as a 1" by 12" in nominal dimensions in reality is .75 inches by 11.75 inches. Scribner log rule assumes all lumber produced comes in even sizes, (2, 4, 6, 8,...) and that a 1/4" sawkerf is used to cut lumber. It also only scales volume based on the diameter at the small end of the log. As discussed previously, the difference between board foot of lumber predicted by Scribner log rule and actual mill recovery is called overrun and may vary considerably, depending on diameter and species of the log, as well as the size of lumber cut at respective mills. Cubic conversions must deal with these discrepancies in raw log inputs, lumber, and other product outputs. Lumber outputs are also reported in nominal board feet. For instance, twelve 1" by 12" by 12" nominal size boards from the mill should equal to one



**Figure 1. Nominal board foot diagram. The figure above represents an example of the difference between a nominal board foot and the actual size as sold in commerce.**

cubic foot, (i.e., 12 board feet per cubic foot conversion). But, the actual volume in cubic feet in this example is 5.45 board feet per cubic foot. The actual cubic conversion will vary depending on the size of lumber produced as well as the state of processing, (rough sanded, kiln dried, etc.). A discussion of how volume was derived for each industry grouping is included in Appendix B of this paper.

### **Defining the Forest Products Industry**

Definitions of what constitutes the forest products industry differ from source to source. The most accepted form of defining an industry is by use of the Standard Industrial Classification (SIC) code system. These industry definitions are described in the Standard Industrial Classification Manual: 1987. Many studies define the forest products industry as those establishments falling into major group 24 - lumber and wood products, except furniture, and major group 26, paper and allied products. In this study industries are included in the forest products industry first by its use of wood as the primary raw material used in production, and second, as an industry dependent on timber supply to survive. For instance, if harvest is further restricted, fewer forestry services personnel are needed. Reductions in timber harvest limit supply, thereby reducing jobs in log, lumber, and other wood products hauling. Most hauling is not included in lumber and wood products, but under transportation SIC codes. To get a complete and accurate picture of how forest products contribute to the Oregon economy, the definition of wood products industries must not be limited to those which fall under major groups 24 and 26. The following pages detail the groupings included in this study.

## **Raw Materials**

Forestry, as defined in this study, includes Standard Industrial Code (SIC) 0831, forest nurseries and gathering of forest products, SIC 0851, forestry services, and SIC 0811, forestry tracts. The first group, 0831 is primarily engaged in the growing of trees for the purposes of reforestation or the gathering of forest products. Establishments included in this industry include forest nurseries, establishments engaged in the distillation of gum, rosin, turpentine, and/or the gathering of seed, bark, greens, moss, and sap. SIC 0851, forestry services, are establishments primarily engaged in services related to timber production, such as, timber cruising, fire-fighting, pest management, reforestation, and marketing. SIC 0811 are establishments primarily engaged in the operation of timber tracts or tree farms for the purpose of selling standing timber. There was much debate as to whether this last category should be included. No resolution was reached, but in this case it was included.

Logging operations, classified as SIC 2411 are establishments primarily engaged in the harvest of standing timber. Establishments or contractors such as those who are engaged in estimating and hauling timber but who perform no cutting operations are classified else.

## **Primary Converting**

In the primary converting industries, outputs may be in the form of products available for direct consumer use, while others may be used as inputs into the secondary converting industries. Residues from these industries are also used as inputs into other industries and/or utilized for fuel in plant

operation. In this study an attempt was made to quantify residues and bark volumes as well as product output volumes from each industry grouping.

Shake, shingle and split rail operations are classified as SIC 2429, special products sawmills, not elsewhere classified. These establishments are mills primarily engaged in manufacturing excelsior, wood shingles, and cooperage stock.

Plywood and veneer mills include SIC 2436, softwood veneer and plywood and SIC 2435, hardwood veneer and plywood.

Sawmills and planing mills includes SIC 2421 and SIC 2426. The first are establishments sawing rough lumber and timber from logs and bolts, or resawing cants and flitches into lumber, including box lumber and softwood cut stock; planing mills combined with sawmills; and separately operated planing mills which are primarily engaged in producing surfaced lumber. This industry also includes firms primarily engaged in sawing lathe and rail road ties and in producing tobacco hogshead stock, wood chips, and snow fence lathe" (Bureau of Census, 1992). Industries classified as SIC 2426 are hardwood dimension and flooring mills. Other products produced in this category include block which is remanufactured in secondary industries to produce bowling pins, handles, carvings, chair frames and seats, and gun stocks.

Post, pole, and piling mills fall under SIC 2491, wood preserving. Firms in this industry are primarily engaged in treating wood, sawed or planed in other establishments, with creosote, or other preservatives to prevent decay and to protect against fire and insects. This industry also includes the cutting, treating, and selling of poles, posts, and piling, but establishments primarily engaged in manufacturing other wood products, which may also be treated with preservatives, are not included (Census of Manufacturers 1992). Some products in SIC 2491 include treated wood for bridges, flooring, millwork, mine

ties and props, and foundation and marine piles, rail ties, structural lumber, and fence.

Pulp mills, SIC 2611 are establishments primarily engaged in production of pulp from wood or from other materials such as rags, linters, wastepaper, and straw. Establishments engaged in integrated logging and pulp mill operations are classified according to the primary products shipped. Establishments engaged in integrated operations of producing pulp and manufacturing paper, paperboard, or similar products are classified in industry 2621 if primarily shipping paper or paper products; in Industry 2631 if primarily shipping paperboard or paperboard products, and in Industry 2611 if primarily shipping pulp. Establishments engaged primarily in cutting pulpwood are classified in Industry 2411 (Census of Manufacturers 1991).

In Oregon, all pulp mill establishments are integrated with paper, paperboard, and/or converted paper product producing establishments. Because they are integrated, and Oregon's pulp mills primarily produce other products as well, the Census of Manufacturers shows no jobs directly under the SIC 2611 classification. Instead, jobs and value added are grouped together and reported in this study under a blanket classification, 'paper and allied products'. Pulp mills are categorized in this study as a primary converter because they use raw materials such as logs to produce their final output. They also use residue produced from primary converting mills, and recovered paper to produce their final output which would also place them in the secondary/residue converting sector.

## **Secondary / Residue Converting**

Board and paper mills, are classified as SIC 2631 and 2621 respectively. Paperboard and paper mills are establishments primarily engaged in manufacturing paper or paperboard, and may also manufacture converted paper or paperboard products. Establishments that primarily manufacture converted board products are classified in industry 265 or 267, converted board and paper products. Converted board and paper products are mainly comprised of final consumer products, such as, boxes, tissue papers, envelopes, etc. that are produced from stock made in board and paper mills. Establishments primarily engaged in manufacturing insulation board or reconstituted wood fiberboard are classified in industry 2493. Industries classified as SIC 2621 and 2631 are establishments primarily producing paper and board in rolls or as stock to be used in making converted paper products. Oregon is a net exporter of these products.

Converted paper and paper board products include SIC 2652, setup paperboard boxes; 2653, corrugated and solid fiber boxes; 2655, fiber cans, tubes, drums and similar products; 2656, sanitary food containers, except folding; 2657, folding paperboard boxes, including sanitary; 2671, packaging paper and plastics film, coated and laminated; 2672, coated and laminated paper not elsewhere classified; 2673, plastics, foil, and coated paper bags; 2674, un-coated paper and multi-wall bags; 2675, die-cut paper and paperboard and cardboard; 2676, sanitary paper products; 2677, envelopes; 2678, stationary; tablets, and related papers; 2679, converted paper and paperboard products not elsewhere classified (Census of Manufacturers 1992). Note that some of these industries may use a small amount of raw material other than wood.

An output volume was not available for this industry although many experts agree that Oregon is a net exporter. This industry also is combined with board and paper mills and pulp mills. Many plants are integrated, producing pulp, board and paper, and converted board and paper at the same location. Value added and employment for this and all SIC 26 industries is reported in the results section under the 'paper and allied products' heading.

Reconstituted wood products, SIC 2493, include establishments primarily engaged in producing hardboard, particle board, insulation board, medium density fiberboard, and waferboard. This industry receives material inputs from the board and paper industries and mill residues to produce its product.

Structural members, SIC 2439 are industries primarily engaged in producing laminated or fabricated trusses, arches, and other structural members of lumber. Products include glue-lam beams, I-joists, and laminated veneer lumber. This category may also be referred to as engineered wood products. Much of the material used to produce these products is initially produced in sawmills, and plywood and veneer mills. Oriented strand board, which is not produced in Oregon, may also be used in these products.

Millwork, as defined in this study includes SIC 2431, millwork and SIC 2434, wood kitchen cabinets. Products produced in these establishments include such diverse products as awnings, blinds, doors, garage doors, molding, and window trim and sash.

Selected Wood Furniture in this study includes selected industries based on wood as the primary material used in production. Those included are SIC 2511, wood and household furniture except upholstered; 2517, wood television, radio, phonograph, and sewing machine cabinets; 2541, wood office and store fixtures, partitions, shelving, and lockers; and 2521 wood office furniture. Other four digit classifications in the 25 grouping were excluded in this study because

the product is made primarily of material other than wood, although wood may be a component in many cases.

Materials handling as defined in this study includes products used primarily to ship other products. This category includes SIC 2441, nailed and lock corner wood boxes and shooks; 2448, wood pallets and skids; and 2449 wood containers.

Miscellaneous wood products, not elsewhere classified, as defined in this study include SIC 2499. These establishments are primarily engaged in manufacturing miscellaneous wood products, such as wood baking equipment, beekeeping supplies, dishes, wood clip boards, ironing boards, boot material, clothespins, police clubs, frames, pressed logs, ladders, etc. A small portion of this category also produces products from rattan, reed splint, straw, veneer, veneer strips, wicker, and willow (Census of Manufacturers, 1992).

Mobile homes (SIC 2451) and prefab wood buildings (SIC 2452) were not included as a wood products industry in this study due to the relatively small ratio of wood costs to other material costs in manufacturing, which permits less dependence on wood supply.

Because of the length and detail of the methods and calculations, a further breakdown and accounting of these procedures, the actual calculations, and data sources are appended to individual results for each sector in Appendix B at the end of this report.

## RESULTS AND DISCUSSION

### Wood Flow and Identification of Economic Sectors

Objectives 1 and 2 of this study were to determine the general flow of wood fiber and the economic sectors involved in harvesting and processing wood products in Oregon. The diagram below depicts the general path that wood fiber takes at each stage of processing.

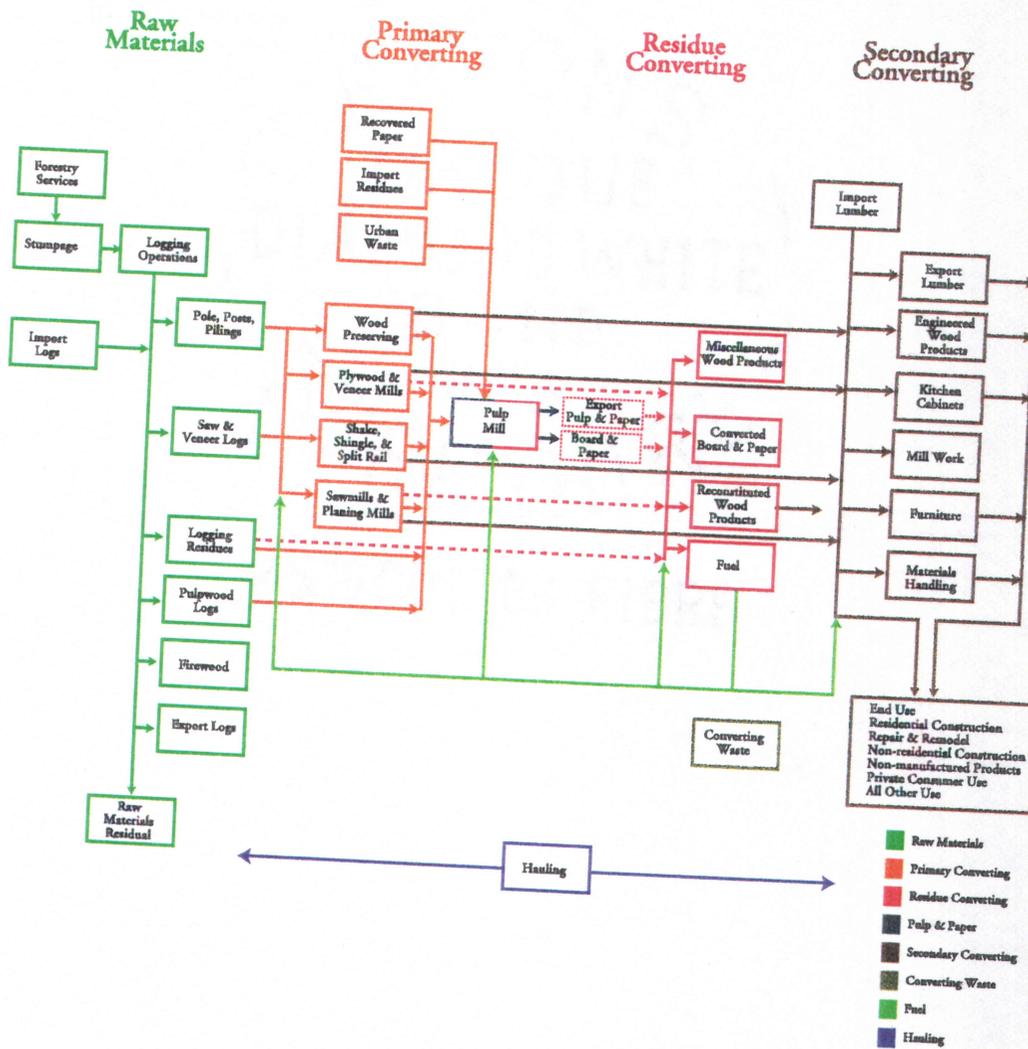


Figure 2. General flow of wood fiber in Oregon.

The process is initiated in the forestry services sector which includes forest regeneration, nurseries, forest protection, and seed gathering industries. Mature timber is then harvested by the logging operations sector. The logs produced in this sector, along with logs imported from out of state, provide the raw material shipped to industries in primary wood products sectors. Primary converting sectors include shake, shingle and split rail mills, (special products mills), pole, post, and piling mills (wood preserving), plywood and veneer mills, and saw and planing mills. Pulp mills and export log firms are also classified as primary converters. Pulp mills utilize raw pulpwood logs, but also use mill residues, urban waste, and recovered paper to produce pulp so may also be considered a secondary/residue converting sector. A certain amount of raw material (logs) produced in Oregon may be exported on the domestic market as well as overseas. As mentioned above, overseas log exporters are also classified as primary converters. These logs flow through Oregon ports but may be shipped from anywhere in the U.S.

Portions of primary sector product output may be shipped either to the final consumer, (i.e., lumber yards, etc.), exported out of state, or may be re-manufactured in the secondary/residue converting sectors. Secondary converting firms include firms which produce structural members (engineered wood products), millwork, kitchen cabinets, furniture, and materials handling products.

Residues and bark produced during harvest and in primary and secondary sectors may be utilized as chips for pulp production, used as fuel for energy production in mills, or used in the manufacture of other wood product outputs such as reconstituted wood products. Product outputs from secondary manufacturing then may be shipped to consumers or exported out of state.

Trucking and transportation of logs and wood products supports the entire wood products production system.

### **Volume**

The third objective of this study was to determine the volume of wood utilized and produced at each stage of processing including residue and bark production. In order to trace volume through each sector and compare inputs to outputs, it is necessary to convert volume to a standard measure throughout the system. Wood products outputs are reported in several different measures, such as board feet, tons, cubic feet, and/or square feet by individual industry sectors. Many products do not have a standard metric conversion further complicating the task of quantifying outputs. Actual cubic volume conversions may differ depending on the state of processing, moisture content, and/or the degree of compaction. For instance, lumber mill residue may include various piece sizes such as slabs, chips, and sawdust. If reported in volume form, the varied amounts of air space may bias the estimate. If reported in weight, varied moisture content can also cause discrepancies when attempting to tally actual wood fiber volume. A more detailed discussion of volume conversion problems can be found in the methodology section of this paper.

Figure 3 indicates estimated totals of wood volume, jobs, and value added for each sector. Total log consumption by primary industries is estimated at 1,547.1 million cubic feet including 35.6 million cubic feet of domestic export. Output from these same industries was estimated at approximately 1,629.8 million cubic feet. This is a five percent difference in the volume estimate between estimated inputs and outputs. Inputs and outputs to primary mills are relatively close considering the difficulty in conversions, differences in reporting

methods, as well as the difficulty in deriving actual input volumes. Of total output, approximately 617.34 million cubic feet (38%) is estimated as wood product<sup>3</sup>, 826.1 mmcf (51%) are in the form of primary mill residues and 186.3 mmcf (11%) are bark and hog fuels. As derived in this study, total output from plywood and veneer mills falls 20 mmcf (5%) short of the estimated input, while output from saw and planing mills is 102.4 mmcf (9%) higher than the estimated input. Actual wood product output totals, particularly for lumber, are probably somewhat higher and residues likely lower than the figures shown because many outputs were based on national averages.

Harvest volumes are troublesome to estimate and are not likely to match outputs due to the current methods of reporting. The common method of reporting log volumes is in Scribner log scale, which was initially based on efforts to predict mill output volumes. Output will generally be greater than input in board foot measures since Scribner log rule is calculated minus defect and is sensitive to taper and species. As average log sizes in the Northwest become smaller, the error continues to have greater significance. This method assumes 1/4 inch saw kerf, even size boards and does not consider the various states of manufactured output by individual mills. Cubic conversions of logs should be able to account for these discrepancies but species and average sizes on the input side must be known. As currently reported in individual sectors, input volumes will not match outputs.

Quantifying total log consumption is also difficult. Annual harvest logs may be carried over from prior years or held over to the next. In addition, there is no system for tracking import logs across state borders. Current data is also unavailable for log exports that move along routes other than through ports for

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<sup>3</sup>Includes export logs. Pulp output includes pulpwood log input only.

	<u>RAW MATERIAL</u>		<u>PRIMARY CONVERTING</u>		<u>SECONDARY CONVERTING</u>			
Private & Public Forestry J=4,076 J=7,732	Import Logs V= <u>137.7</u>	V= <u>1.56</u> Shake Logs	Shake, Shingle & Split Rail Mills J=194 \$=9.1	V= <u>.94</u>	Structural Members V= <u>34.7</u> J=1,520 \$=84.2		Imports N/Q	
		V= <u>382.1</u> Veneer Logs	Plywood & Veneer Mills J=11,458 \$=767	V= <u>147.2</u>	Millwork V= <u>33.9</u> J=9,485 \$=383.7			
		V= <u>1041.2</u> Saw Logs	Sawmills & Planing Mills J=15,420 \$=1140.1	V= <u>374.</u>	Furniture V= <u>n/a</u> J=1,532 \$=66.8			
	Harvest V= <u>1409.4</u>	V= <u>9.3</u> Pole Logs	Pole, Post, & Piling Mills J=346 \$=29.5	V= <u>5.4</u>	Materials Handling V= <u>5.6</u> J=324 \$=10.4		Fuel V= <u>378</u>	
	Logging Residue V= <u>93.7</u>		Mill Residue(incl.bark) V= <u>1004.7</u>		Secondary Residue V= <u>+13.4</u>		Misc. V= <u>+32.9</u> WP J=1,100 \$=44.6	
		V= <u>77.4</u> Pulpwood Logs	Recovered Paper V=94.2 Pulp V= <u>313</u> Mills J=* \$=*	Board & Paper Mills J=* \$=*	V= <u>303.9</u>	Reconstituted Wood Products J=1,868 \$=173.3		
	Firewood V= <u>.08</u>	V= <u>35.6</u> Export Logs				Converted Board & Paper V= <u>n/a</u> J*=8995 \$*=1694.4		
	Hauling J=12,000		Overseas log export V=131.3 J=1024			Other Exports Chips= 141.3 Pulp=15.3 Lumber=37.7		
	*Jobs and value added for pulp, board, and paper industries are combined due to disclosure.							
	V=volume in millions of cubic feet. J=employment in actual figures. \$=value added in millions of dollars.							

Figure 3. 1992 Value, Volume, and Jobs

overseas and even these log sources are difficult to identify. A portion of log consumption is imported from other states while some is exported, especially to California and Washington.

Residues are highly utilized in Oregon. The 1992 draft mill survey reports that of all residue produced, 79 percent was in the form of chipable wood while 21 percent was bark residue. Of that, 60 percent of wood residue was utilized in pulp and board industries. Fuel to generate energy accounted for 33 percent of wood residue use, up from 25 percent in the 1988 survey. Eighty-three percent of total bark output was also utilized as fuel in 1992, somewhat less than the 1988 survey which indicated 87 percent of bark went to fuel. The remaining bark is utilized in miscellaneous wood products industries. Total fuel volume from residue is estimated at 378 mmcf.

Volume outputs from many secondary industries, such as kitchen cabinets (included in millwork), furniture, and converted board and paper were not available. A direct volume estimate for miscellaneous wood product output was also unavailable, although, sixteen percent of bark residue is estimated to be input into the miscellaneous wood products industries. Based on that input alone, volume output for this industry would be at least 32.9 mmcf.

Pulp mill volume output indicated in figure 3 of 313 mmcf includes 77.4 mmcf of pulpwood log. Thirty percent (23.2mmcf) of this is estimated to be bark which may be utilized as fuel or in other industry production. In addition, 94.2 mmcf recovered paper and 164.6 mmcf mill residue chips are estimated as input to this industry.

Overseas export logs accounted for 131.3 mmcf (788,000 mbf) of volume. In addition, 37.7 mmcf of lumber was exported in 1992 through Oregon ports (WWPA). Warren (1993) estimated that 141.3 mmcf of chips and 15.3

mmcf of pulp was exported from the Columbia Snake Customs District (which includes Longview and Vancouver).

The following pages highlight harvest and volume production trends in selected sectors of the wood products industries in measures reported by industry. While not an objective of this study, these trends help define the importance of wood products industries and impacts resulting from increased restrictions on federal harvest in Oregon, as well as provide ability to compare results to past studies which are generally reported in board feet.. For cubic volume tables see Appendix B; Calculations and Data Sources. Table 1 indicates Oregon harvest levels from 1982 to 1993. National forest harvest levels have declined by 586 million board feet in the last ten years, while private harvest has increased by only 168 million board feet (mmbf).

YEAR	PRIVATE	STATE	NTL. FOREST	BLM	BIA	OTHER PUBLIC	TOTAL HARVEST
1982	3440	175	1688	312	126	17	5758
1983	3374	257	2902	789	112	31	7464
1984	3078	249	3164	920	101	38	7550
1985	3332	268	3480	891	121	34	8127
1986	3494	225	3850	1042	104	28	8743
1987	3281	199	3451	1115	117	52	8215
1988	3259	270	3487	1439	121	39	8615
1989	3721	198	3307	1026	124	44	8420
1990	3229	137	2014	704	98	37	6219
1991	3312	91	2068	486	87	36	6080
1992	3581	135	1403	483	111	29	5742
1993	3608	116	1102	361	75	31	5293

SOURCE: WARREN 4TH QUARTER 1993

**Table 1. Oregon harvest trends: 1982 - 1993 (mmbf)**

Total harvest levels have declined below 1982 levels. The 1993 cut was 3,450 mmbf below the 1986 high of 8,743 mmbf. Lumber production shown in Table 2, has closely followed harvest trends. Lumber production grew to a record high in 1987 but dropped nearly 3,400 mmbf by 1992. During the same time wholesale prices climbed from about \$250 per mbf to nearly \$470 per mbf by 1993.

YEAR	VOLUME (mmbf)	EST. WHLSL. VALUE (\$/mbf)
1982	4682	
1983	6579	
1984	7202	248.9
1985	7211	245.5
1986	8149	249.0
1987	8846	277.0
1988	8601	284.2
1989	8512	301.5
1990	7511	292.7
1991	6595	297.5
1992	6200	349.4
1993	5448	467.6

Source: Western Wood Products Association

**Table 2. Lumber Production in Oregon, 1982-1993**

### **Jobs**

The fourth objective of this study was to identify the number of jobs directly related to wood products in each sector. Details of the method of selection of pertinent industries are discussed in the methods section of this

paper. The two most widely reported SIC classifications included as wood products industries are SIC 26, paper and allied products, and SIC 24, lumber and wood products. In this study, several others industries were included, because changes that affect wood supply significantly impact these industries, but for purposes of comparison between other studies, these two classifications are highlighted in the following tables. Table 3 indicates jobs in SIC 24 and SIC 26 industries between 1982 and 1993.

Lumber and wood products employment has continued to decline annually since 1987 as restrictions on federal harvest become tighter. Paper and allied products have also shown declining employment but have been relatively less impacted by supply.

YEAR	LUMBER & WOOD PRODUCTS	PAPER & ALLIED PRODUCTS
1982	55.6	9.6
1983	62.6	9.3
1984	66.7	9.0
1985	63.6	9.1
1986	63.9	9.0
1987	66.5	8.9
1988	67.9	8.9
1989	67.0	9.1
1990	63.7	9.1
1991	57.1	9.3
1992	54.0	9.0
1993	53.4	9.1

SOURCE: WARREN 4TH QTR 1993. Reported in thousands of jobs.

**Table 3. Oregon Employment in SIC 24 & SIC 26: 1982 - 1993** Jobs include logging, lumber, poles and piling, and miscellaneous wood products except furniture.

Table 4 shows individual industry employment for SIC 24 from 1988 to 1992. The two largest SIC 24 industries, saw mills and planing mills, and veneer and plywood mills have been severely impacted. Softwood veneer and plywood plants lost more than 6,000 jobs between 1988 and 1992. Saw and planing mills also employed nearly 6,200 fewer people between 1988 and 1992. Millwork and wood kitchen cabinets, and the shipping and handling industries are showing increasing employment while most other SIC 24 industries have fewer employees.

SIC		1988	1989	1990	1991	1992
2411	Logging operations	13035	12611	11425	10007	10197
2421	Saw & planing mills	21600	21717	20578	17975	15420
2426	Hdwd dimension & floor	738	758	790	742	732
2429	Sawmills special	328	370	291	242	194
2431	Millwork	7714	7227	7421	6765	7899
2434	Wood Kitchen cabinets	1470	1391	1491	1521	1586
2435	Hdwd plywood	962	1329	1346	1145	1210
2436	Softwood veneer & plywood	16294	14461	13209	10795	10248
2439	Structural wood, NEC	1325	1767	1724	1553	1520
2441	Nailed wood boxes	123	161	120	119	78
2448	Wood pallets & skids	195	143	178	211	203
2449	Wood container, NEC	30	48	50	46	43
2451	Mobile homes	1629	1853	1977	2039	2091
2452	Prefab wood buildings	328	204	202	254	328
2491	Wood preserving	406	434	424	405	346
2493	Reconstituted wood products	1812	1652	1948	1905	1868
2499	Wood products, NEC	1502	1407	1199	1166	1100
<b>TOTAL FOR SIC 2</b>		<b>69494</b>	<b>67532</b>	<b>64371</b>	<b>56890</b>	<b>55064</b>

**Table 4. Lumber and wood products, (SIC 24) employment. Source: Oregon Covered Employment. Mobile homes and prefab buildings reported for information only, not included in wood products employment totals in this study.**

Table 5 indicates jobs in paper and allied products have become relatively stable with 152 fewer jobs since 1990, but since 1988 there are 600 fewer jobs in this industry.

SIC		1988	1989	1990	1991	1992
2621	Paper mills	4005	3469	3439	3353	3275
2631	Paperboard mills	1962	1997	2010	2065	1914
2653	Corrugated & solid fiber boxes	680	709	775	801	858
2657	Folding paper boxes			262	245	200
2671	Paper, coated & lam. pkging					465
2672	Paper coated & lam. NEC	350	349	340	425	481
2673	Bags: plastics, lam and coated					42
2674	Bags uncoated papaer & multiwall	313	201	203	216	260
2675	Diecut paper and board		234	279	304	49
2677	envelopes	287				
2679	Converted paper products, NEC	224	234	279	304	100
****	Other paper & allied products	1017	2200	1940	1738	1352
<b>TOTAL FOR SIC 26</b>		<b>8837</b>	<b>9159</b>	<b>9247</b>	<b>9147</b>	<b>8995</b>

**Table 5. Paper and allied products employment: 1988 - 1992 by SIC code**

Selected industries in furniture and fixtures are reported in Table 7. This industry has also grown, gaining 189 employees since 1988. Forestry services employment, SIC 08, (Table 6), had 4,076 jobs in the private sector and an additional 7,732 in state and federal employment in 1992. Other employment included in this study are hauling jobs and export jobs. Wood products hauling jobs were estimated by Spriggs in 1988 at 15,000. A current estimate for 1992 was unavailable. This industry most likely has fewer jobs due to lower production in the wood products industry. Overseas export jobs were estimated at 1,024 in 1992.

Industries falling under SIC 24 and 26 alone represented about 5 percent of statewide employment in 1992. Statewide employment in Oregon was 1,257 thousand with 63.3 thousand jobs in SIC 24 and 26. The addition of 1,532 jobs in selected furniture, 1,024 jobs in log export firms, 4,076 jobs in private forestry services, 7,464 in federal and state forestry services, and possibly in excess of 10,000 jobs in hauling; wood products employment accounts for more than 6.8 percent of Oregon employment, for a total of 85,846 jobs in 1992.

			1988	1989	1990	1991	1992
08XX	PRIVATE	TOTAL	3739	4128	4349	4371	4076
	811	Timber Tracts					1162
	831	Forest Products					290
	851	Forestry Services					2624
811	Federal	Timber Tracts	7069	7851	7988	7484	7464
811	State	Timber Tracts					168
831	State	Forest Products					100
		<b>TOTAL FOR O8</b>	<b>10808</b>	<b>11979</b>	<b>12337</b>	<b>11855</b>	<b>11808</b>

Table 6. Forestry employment: 1988 - 1992 by SIC code.

SIC		1988	1992
2511	Wood household furniture	655	585
2517	Wood tv & radio cabinets		48
2521	Wood office furniture	186	116
2541	Wood partitions & fixtures	502	783
	<b>TOTAL FOR SIC 25</b>	<b>1343</b>	<b>1532</b>

Table 7. Selected furniture employment: 1988 and 1992 by SIC code.

SIC		1988	1992
*42	Hauling	15000	12000
*	Overseas export	-	1024

**Table 8. Other employment.**

### Value Added

The fifth and final objective of this study was to quantify value added in manufacture for each industry. The 1992 census of manufactures reports were not yet available; therefore, value added in this report is based on a

SIC		1987 VA	1992 VA	1987 PR	1992 PR
2411	Logging operations	796.9	755.0	283.3	268.4
2421	Saw & planing mills	1062.0	1094.7	455.8	469.9
2426	Hdwd & dim. flooring	D	45.4	D	17.7
2429	Sawmills special	D	9.1	D	3.0
2431	Millwork	222.4	320.7	129.9	187.3
2434	Wood kitchen cabinets	40.8	63.4	22.6	35.1
2435	Hdwd veneer & plywood	71.1	86.9	27.5	33.6
2436	Sftwd veneer & plywood	786.1	680.1	348.7	304.0
2439	Structural wood, NEC	66.9	84.2	34.5	43.4
2441	Nailed wood boxes	D	*	D	1.0
2448	Wood pallets & skids	7.3	*	3.2	3.7
2449	Wood containers, NEC	-	10.4	-	1.3
2451	Mobile homes	53.5	-	24.2	51.0
2452	Prefab. wood buildings	2.4	-	4.8	6.8
2491	Wood preserving	27.2	29.5	9.7	10.6
2493	Reconst. wood products	192.8	173.3	65.2	58.6
2499	Wood products, NEC	28.2	44.6	13.9	22.0
<b>TOTAL FOR SIC</b>		<b>3385.3</b>	<b>3396.9</b>	<b>1432</b>	<b>1517.1</b>

**Table 9. Value Added & Payroll - Lumber & Wood Products (SIC 24): 1987 & 1992. 1987 value added and payroll and 1992 payroll is actual, 1992 value is estimated.**

ratio of 1987 value added and payroll, and 1992 payroll. The previous table indicates 1987 value added and payroll, and 1992 payroll with the estimated 1992 value added reported in millions of dollars.

Average annual pay for SIC 24 and SIC 26 industries was \$30,000; \$6,500 higher than the statewide average of \$23,500 in 1992. Estimated value added in manufacture represented nearly 5.2 billion dollars in 1992 up from 4.6 billion dollars in 1987.

		1987 VA	1992 VA	1987 PR	1992 PR
2621	Paper mills	441.9	*	105.3	165.3
2631	Paperboard mills	382.3	*	77.6	87.9
2653	Corr & solid fiber box	36.8	*	19.3	30.6
2657	Folding paper box	D	*	D	6.1
2671	Paper, ctd. & lam. pkging	D	*	D	14.1
2672	Paper ctd & lam, NEC	D	*	D	18.1
2673	Bags: plastics, lam. & coated	-	*	-	0.7
2674	Bags: uncoated paper & multi-wall	16.7	*	6	7.8
2675	Diecut paper & board	-	*	-	1.6
2679	Converted paper products, NEC	14.5	*	6.7	2.8
****	Other paper and allied products	-	*	-	55.7
<b>TOTAL FOR SIC 26</b>		<b>1156.6</b>	<b>*1694.4</b>	<b>266.6</b>	<b>390.6</b>

**Table 10. 'Value Added & Payroll - Paper & Allied Products (SIC 26): 1987 & 1992. D' in tables refer to information not reported due to disclosure. There may be too few firms in this industry allowing the reader to infer an individual firms value added or payroll. Value added and payroll for these industries are included in end totals.**

		1987 VA	1992 VA	1987 PR	1992 PR
2511	Wood Household furniture	26.7	*	12.9	9.9
2517	Wood TV & radio cabinets	-	*		0.7
2521	Wood Office Furniture	-	*		2.2
2541	Wood partitions & fixtures	18.7	*	9.9	18.5
<b>TOTAL FOR SIC 25</b>		<b>45.4</b>	<b>66.8</b>	<b>22.8</b>	<b>31.4</b>

**Table 11. Value Added & Payroll - Wood Furniture (SIC 25), selected industries. 1992 value added was unavailable for individual industries.**

## SUMMARY & CONCLUSION

The purpose of this study was to examine wood fiber flow and identify each sector, the related jobs, and value added for each. Current available data renders this task difficult at best. The definition of what constitutes the wood products industry can have considerable impact on related employment figures leading to underestimated economic impacts due to changes in timber management policies. It is clear that wood products are still an integral part of Oregon's economy accounting for 5 to 7 percent of Oregon's employment, over \$5 billion in value added in manufacture, and in excess of \$2.2 billion in payroll, (excluding hauling and overseas export), in 1992.

### **Importance And Use Of This Information**

The wood products industry is undergoing a time of acute change. As Spriggs (1993) stated, estimates of wood products employment continues to be surrounded by confusion hindering effective decision making for government planners and private businesses. The same can be said for volume estimates and the resulting economic impacts of changing timber supply. Economic impact analysis to estimate the level of change on employment and related local revenues and the ability to make competent forest management policy decisions requires valid, comprehensive information.

Many studies have analyzed the importance of the wood products industries to Oregon, but their methods and data sources are often very different. This leads to inconsistencies and confusion when trying to compare estimates from different sources. In this study, an attempt was made to comprehensively track the flow of wood from the stump to final product or export,

accounting for jobs and value added at each stage. This provides a complete picture of the entire industry, as well as a detailed look at all the components.

As forest policy becomes even more contentious, an accurate assessment of the wood products industry becomes more important. Policies which affect log supply will have forward-linked impacts. An accurate picture of the structure and linkages of the many sectors is necessary for effective policy analysis.

It is important to emphasize that many of the sectors included in this study are linked to each other. This means that one industry is supplying another with a production input. Therefore, it would be inaccurate to apply multipliers to each output or job estimate in this study. Multipliers should only be used with exports of a product outside of a region (in this case, the state of Oregon). This means that an estimate of how much product is exported at each stage of processing is necessary in order to estimate indirect and induced impacts of the wood products industry.

### **Future Research Needs**

#### **Inputs to Primary Converting**

Oregon harvest levels continued to decline in 1992 to 1409 mmcf, the lowest level in over 10 years. Total log consumption by primary industries is estimated at 1,547.1 mmcf with imported logs making up the difference between harvest and consumption. Harvest volumes are difficult to estimate and rarely match outputs because of current reporting methods. The current method of reporting log volumes is in Scribner log scale, which was initially based on efforts to predict the quantity of mill output. Output volumes are generally greater than input in board foot measures because Scribner log rule subtracts

defect and is sensitive to taper and species. As average log sizes in the Northwest become smaller, the error is magnified. This method, as mentioned before, also assumes 1/4 inch saw kerf, even size boards, and ignores the various states of manufactured output by individual mills. Cubic conversions of logs should be able to account for these discrepancies but species and average sizes on the input side must be known. In order to obtain the highest degree of accuracy, a shift from Scribner to gross cubic foot log scaling would be ideal. In light of continued resistance to converting to cubic reporting methods<sup>4</sup>, a statistical sampling of harvest in cubic volumes that are representative of Oregon could be developed. As data are currently reported in individual sectors, inputs will not match outputs. Possibly compounding the error in this study, is the use of national averages in many sectors, which in general have lower recovery ratios than Oregon.

Quantifying total log consumption is also difficult. Annual harvest logs may be carried over from prior years or held over to the next. In addition, there is no system for tracking logs imported across state borders. A possible solution may be to set up random sampling stations at state borders to acquire a more accurate estimate of regional imports in a future study. Currently, the PNW Research Station conducts 100 percent surveys of mills in which they question mill operators as to where they've purchased logs from, but the most recent survey was hindered by a poor response rate. It is possible that incentives could be provided to induce mill operators to respond. Current data is also unavailable for log exports that move along routes other than through ports for overseas and even the sources of these logs are difficult to identify. A portion of

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<sup>4</sup>Although recent unconfirmed reports indicate that Willamette Industries as well as the Forest Service may be switching to cubic foot measures.

log consumption is imported from other states while some is exported, especially to California and Washington but are very difficult to quantify.

### Outputs From Wood Products Industries

Impacts of declining harvest levels are further expressed in declining production levels from the primary sector. Lumber production has fallen from a high of 8,846 mmbf in 1987 to 6,200 mmbf in 1992, closely following harvest trends. The year 1992 showed a 12.1 percent decrease from the previous year, yet Oregon continued to be the largest lumber producer in the U.S. and accounted for 32.1 percent of total softwood production in the west (WWPA 1993). Likewise, plywood and veneer output continues to fall with output estimated at 147.2 mmcf in 1992.

Outputs from both primary and secondary industries are difficult to quantify and compare because of differences in reported measures such as square feet, board feet, or tons. In addition, output volume estimates were not available for some industries such as furniture and converted board and paper, or, the method used to determine volume may have a high degree of error. Standard cubic conversion factors are needed to accurately quantify product outputs. Lumber tallies need to be reported in a consistent measure to get a complete and accurate picture of actual volumes. In addition, residue and bark factors need to be updated to represent current manufacturing practices and reported in standard volume measures and/or with accurate cubic conversions.

The amount of residue and bark used by mills for energy is difficult to quantify. An estimated 83 percent of bark and 60 percent of other wood residue was utilized as fuel in 1992. In addition 33 percent of the remaining wood residue was used in the pulp and board industries, but determining actual

volumes is difficult due to differences in reporting methods and the state of residue output at the time it is reported. Research is needed in these areas to gain an accurate accounting of all wood fiber utilized. Work has been done to provide accurate cubic conversions in some instances, such as I-joist production.

Actual output volumes were not available for wood preserving, or special products mills in the primary industries. In the secondary/residue converting industries actual volumes were available for structural members only. Sources of logs that are exported overseas through Oregon ports are difficult or impossible to determine because they may include logs from many states but are an important component in Oregon's wood products industries. Oregon ports shipped 131.3 mmcf of logs in 1992. Harvest restrictions on federal timber in other states also effect this industry. In addition, 54.4 percent of all U.S. lumber exports were also shipped through West Coast Ports in 1993 (WWPA 1994).

#### Defining the Wood Products Industry, Jobs, and Value Added

A standard definition of what constitutes the wood products industry is needed. At the very least, studies on regional impacts should explicitly define which industries are included. Hauling, log and lumber export, and other manufactured wood products exports are closely tied to the wood products industry. Hauling supports the entire flow of wood fiber through the economy but is rarely included. Spriggs reported that in 1988, there were an estimated 15,000 truckers hauling wood products in Oregon. Likewise, some sectors of furniture manufacturing are heavily dependent on wood as the primary raw material and yet, they are also frequently excluded. Forestry services, (SIC 08), when federal and private jobs are combined, represented nearly 12,000 jobs in

1992. On the other hand, many studies may include mobile home manufacturing because it falls in SIC 24, lumber and wood products, yet wood is a relatively small factor in production of this commodity. Impact analysis and studies need to state which industries are being included so they may be accurately compared to past studies.

With the exception of millwork, wood kitchen cabinets, and hardwood plywood, all SIC 24 industries had fewer employees in 1992. Two of the heaviest hit were lumber mills and plywood mills, together losing 12,200 jobs between 1988 and 1992. There were approximately 54,000 persons employed in SIC 24, lumber and wood products and 9000 people in SIC 26, paper and allied products in 1992. Including the more than 13,000 jobs in forestry services, selected wood furniture, and export jobs, and possibly 10,000 jobs in hauling, total employment in wood products related industries for 1992 is nearly 90,000.

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**APPENDICES**

## APPENDIX A - Definitions

Many definitions were derived from Briggs (1994) and Sessions et. al. (1991) Some were modified to describe terms as used in this report.

**Adhesive** - A substance capable of holding materials together by surface attachment. It is a general term and includes cements, mucilage, and paste, as well as glue

**Air-dry wood** - Dried by exposure to air in a yard or shed, without artificial heat.

**bf** - board feet

**Board foot** - A unit of measurement of lumber represented by a board 1 foot long, 12 inches wide, and 1 inch thick. This measurement implies 12 board feet per cubic foot. In practice, the board foot calculation for lumber 1 inch or more in thickness is based on its nominal thickness and width and the actual length. Lumber with a nominal thickness of less than 1 inch is calculated as 1 inch.

**Board foot/cubic foot ratio** - The relationship between the board foot and cubic foot measure of a log, tree, or lumber. The number of board feet in 1 cubic foot of log varies with log length and log diameter. In this study the board foot (Scribner log rule) to cubic foot ratios are 6 board feet per cubic foot of timber volume.

**Bone-dry unit (BDU)** - A quantity of wood residue that would weigh 2,400 pounds at zero percent moisture content.

**cf** - cubic feet

**Cord** - Fuelwood or pulpwood are often sold in cords, stacked piles of split or unsplit, with or without bark. A standard rough cord occupies 128 gross cubic feet usually comprising 4 foot long split or unsplit roundwood generally with bark stacked in a pile 4 feet high by 8 feet long. Occasional stacks of longer pieces, such as 8 foot lengths are estimated in terms of standard cords. The volume of solid wood in a cord is difficult to represent accurately because of the amount of air space, varied length, diameter, bark thickness and surface roughness of the pieces. An average conversion factor commonly used is 85 cubic feet per cord of wood per standard rough cord. The USFS assessment assumes 79.2 cubic feet per cord.

**Converted paper and board** - The paper products such as toilet tissue, stationary, boxes, and paper bags manufactured from bulk paper and board produced in paper and board mills.

**Cubic recovery ratio (CRR)** - In a material balance diagram, the ratio of wood product recovered divided by the wood raw material used, both measured in cubic volume. The fraction of wood raw material converted to the intended product. The reciprocal of the CRR is the number of cubic feet of roundwood log needed to produce a cubic foot of lumber in the particular manufactured size. The U.S. Timber assessment assumes 0.362 CRR for softwood lumber, meaning 2.76 cubic feet of input are needed to produce each cubic foot of mostly surface dry lumber. A CRR of 0.499 is used for hardwood, meaning 2.00 cubic feet of log is needed for each cubic foot of mostly rough green hardwood produced.

**Cunit** - A measurement equal to 100 cubic feet of solid wood.

**Defect** - A characteristic of a the, log, lumber, or other product that makes it either less desirable or completely unsuitable for the intended purpose. Examples are knots, decay, and diagonal grain.

**Diameter inside bark (dib)** - A measurement used in log scaling.

**East-side Scribner** - Reference to the method of applying the Scribner log rule and obtaining log measurements, other than in western Oregon and Washington.

**Engineered wood products** - These are primarily load bearing wood members manufactured from lumber, veneer, and oriented strand board to produce products such as laminated trusses, glu-lam beams, laminated veneer lumber and I-joists.

**Expansion factor** - With respect to chips, bark, sawdust, and shavings, the ratio of volume occupied in one of these forms to the volume of soled wood before conversion.

**Export** - In this study, export refers to transport of logs out of Oregon. Offshore export refers to logs shipped to another country from Oregon.

**Fiberboard** - A broad generic term inclusive of sheet materials of widely varying densities manufactured of refined or partly refined wood or other vegetable fibers. Bonding agents and other materials may be added to increase strength, resistance to moisture, fire, decay, or to improve some other property.

**Flitch** - A portion of a log sawn on two or more faces- commonly on opposite faces leaving two waney edges. When intended for resawing into lumber, it is resawn parallel to its original wide faces. Or, it may be sliced or sawn into veneer, in which case the resulting sheet of veneer laid together in the sequence of cutting are called a flitch. The term is loosely used.

**Glue laminating** - Production of structural or nonstructural wood members by bonding two or more layers of wood together with adhesive.

**Green** - Freshly sawed or undried wood.

**Gross scale** - The volume of a log obtained from original geometric measurements without adjustments for potential processing losses associated with crookedness, decayed regions, and so forth.

**Hardboard** - A generic term for a panel manufactured primarily from interfelted lignocellulosic fibers (usually wood), consolidated under heat and pressure in a hot press to density of 31 pounds per cubic foot or greater, and to which other materials may have been added during manufacture to improve certain properties.

**Hardwoods** - Generally one of the botanical groups of trees that have broad leaves in contrast to softwood .

**Hog fuel** - A product made by reducing waste pieces of lumber and slabs, bark or small tree stems to chips used mainly as fuel.

**Import** - In this study, import refers to transport of logs into Oregon from outside the state.

**Kiln-dry wood** - Dried in a kiln with the use of artificial heat to a specified moisture content.

**Laminated veneer lumber (LVL)** - A structural lumber manufactured from veneers laminated into a panel with the grain of all veneer running parallel. The resulting panel is generally manufactured in 3/4 to 1-1/2 inch thickness and ripped to common lumber widths of 1-1/2 to 11-1/2 inches, or wider.

**Logging operations** - These industries are primarily engaged in harvesting.

**Lumber dimensions** - Actual size: The dimensions obtained when an individual piece of lumber is measured. Manufactured size: The dimensions for a given state of manufacture that are provided in product specifications. Examples are rough-green and surface-dry. The manufactured size stated in the American Lumber Standard for a surfaced-dry 2" by 4" is actually 1.5 by 3.5 inches.

**Nominal size:** As applied to timber or lumber, the size by which lumber is known and sold and the basis used to calculate lumber volume in board feet, i.e. 2" by 4".

**Lumber recovery factor (LRF)** - An expression of the number of board feet of lumber obtained by a sawmill per cubic feet, log scale, of log input.

**Materials handling** - Materials handling industries in this report include industries which produce materials used for shipping of other products such as wood pallets and skids, corner wood boxes and shook, and wood containers.

**mbf** - Thousand board feet.

**mmbf** - Million board feet.

**mmcf** - million cubic feet.

**Medium density fiberboard (MDF)** - A panel product manufactured from lignocellulosic fibers combined with a synthetic resin or other suitable binder. The panels are manufactured to a density of 31 pcf (0.50 specific gravity) to 55 pcf (0.88 specific gravity) by the application of heat and pressure by a process in which the interfiber bond is substantially created by the added binder. Other materials may have been added during manufacturing to improve certain properties.

**Miscellaneous wood products** - As classified in this study, are all wood products not elsewhere classified, such as pressed logs, ladders, wood dishes, clip boards and many other miscellaneous wood products.

**Millwork** - In this study, millwork includes wood kitchen cabinets, as well as such diverse products as awnings, blinds, moldings and doors.

**Moisture content** - The amount of water contained in the wood, either expressed as a percentage of the weight of the oven-dry wood or as a percentage of total weight of a piece.

**Net scale** - Log volume less defect scaling deductions.

**Oven-dry wood** - Wood dried to a relatively constant weight in a ventilated oven at 102 to 105 degrees C.

**Overrun** - The excess lumber, in board feet, actually sawn from logs compared to the amount of lumber predicted by a board foot log scale; usually expressed as a percent of log scale.

**Paperboard** - A general term describing sheets made of fibrous material 0.012 inch or more in thickness. Compared with paper, paperboard is heavier per unit area, thicker, and more rigid. Paperboard is the term used to describe any single variety, or group of varieties, of board material used in the production of boxes, folding cartons, and solid fiber and corrugated shipping containers.

**Primary converting** - These industries produce solid wood products from raw logs that may be shipped to consumers or remanufactured into products in the secondary industries.

**Reconstituted wood products** - These products include hardboard, particle board, insulation board, medium density fiberboard and waferboard. These products are produced from materials originally manufactured in the paper and board industries and/or from mill residues.

**Recovered paper** - Recycled paper used with wood chips to produce pulp in paper manufacturing.

**Residue** - Logging residue: Un-merchantable tops, branches, and stumps of felled trees, and logs and standing trees that are too small or defective to be removed economically from the woods during a logging operation. Mill residue: That portion of log input volume that remains after the primary product has been produced.

**Roundwood** - Wood products that are round, such as pulpwood, posts, poles, pilings and fencing materials.

**Sawkerf** - (1) Grooves or notches made in cutting with a saw; (2) that portion of a log, timber, or other piece of wood removed by the saw as sawdust in cutting the material.

**Secondary converting** - Those industries that use raw material that is first processed in primary converting. For example, structural members are produced from lumber, plywood and veneer originally manufactured in primary mills.

**Shakes** - In construction, a type of shingle usually hand cleft (therefore having rough sides as opposed to shingles which are smooth), from a bolt and used for roofing.

**Softwoods** - Generally, one of the botanical groups of trees that in most cases have needle-like or scale-like leaves, the conifers, also the wood produced by such trees. Softwoods in general have a different average taper as logs and are processed and sold in different forms as lumber than hardwoods requiring different volume conversion factors.

**Solid wood** - Wood as it is observed in a tree, log, or piece of lumber and hence free of manufactured voids as would occur between chips or free of non-woody materials such as resins and other additives.

**Square** - A measurement of the amount of material (e.g., shingles) required to cover a surface area of 100 square feet when applied as recommended.

**Standard Industrial Classification (SIC)** - A classification system used to group industries producing like goods and services. Definitions of these industries as classified are reported in the Standard Industrial Classification Manual: 1987, US government Printing Office, Washington DC.

**Structural members** - see engineered wood products.

**Surfaced-dry (S-dry)** - The condition of lumber that has been air or kiln dried and subsequently planed to a smooth surface.

**Taper** - The gradual diameter reduction of a tree or log from the base to the top.

**Value added** - Value added in manufacturing is the difference between the value of products produced and the cost of materials used to produce them. Value added is generally comprised of labor costs, services, and profits. Higher value added indicates more dollars are likely to be spent on labor and other local services, thereby generating greater impact at the local level.

**Wage and salary employment** - Full- and part- time employees who come under state employment insurance.

**West-side Scribner** - A term commonly used to refer to the method for applying Scribner log scale and taking measurements in western Oregon and western Washington. Assumes 32 foot logs.

## APPENDIX B - Calculations and Data Sources

	VOLUME mmcf	RESIDUE mmcf	BARK	FIREWOOD mmcf
Harvest	1409.4	93.7	*	0.08
Import logs	137.7			
<b>TOTAL</b>	<b>1547.1</b>	<b>93.7</b>	<b>*</b>	<b>0.08</b>
Special saw logs	1.6	-	-	-
Veneer logs	382.1	-	-	-
Saw logs	1041.2	-	-	-
Pole logs	9.3	-	-	-
Pulp logs	77.4	-	-	-
Export logs	35.6	-	-	-
<b>TOTAL</b>	<b>1547.1</b>	<b>-</b>	<b>-</b>	<b>-</b>

\* Bark is included in Residue.

**Fig. B1. Raw material inputs**

### Primary Converting

### Forestry Services

Forestry establishments supported 4,076 jobs in 1992 in the private sector. An additional 7,732 jobs falling under SIC 0811, and 0831 were held by federal and state employees. Volume and value added are not applicable in this case because they are captured in figures for logging operations.

## Logging Operations

The harvest volume together with the volume of logs imported comprises the total raw material consumed in the primary converting industries. In 1992 approximately 137.7 million cubic feet of logs were imported into Oregon.<sup>5</sup> Total log consumption is approximately 1,547.1 million cubic feet.

The draft version of Oregon Forest Products Industry: 1992, (USFS draft) reports that about 67.3 percent of 1992 log consumption was consumed by sawmills, 24.7 percent by veneer and plywood mills, and 5 percent by pulp and board mills. Approximately 0.6 percent of all logs were consumed by the post, pole and piling mills and 0.1 percent by shake, shingle and split rail mills. In addition, 2.3 percent of all logs consumed in Oregon were exported as roundwood. Applying these percentages to the 1409.4 million cubic foot harvest and 137.7 million cubic feet of import logs results in approximately 1.56 million cubic feet input to shake, shingle, and split rail mills, 382.1 million cubic feet of input to plywood and veneer mills and 1041.2 million cubic feet input into sawmills and planing mills. Post, pole, and piling mills consumed 9.3 million board feet and 77.4 million cubic feet were input into the pulp mill industries. 35.6 million cubic feet of logs were exported outside Oregon.

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<sup>5</sup>Volume of imported logs is derived from the draft version, 'Oregon's Forest Products Industry: 1992'; Ward; U.S. Forest Service. Table 3 of the report indicates log flows to all states including Oregon of 4,032,960 mbf and log flows within Oregon at 3,673,761 mbf Scribner log rule. The difference indicates that 8.9% of logs consumed were imports from other states. If 8.9% of consumption equals imports then 91.1% came from the harvest (again assuming all harvest consumed in present year).  $1409.4 / .911 = 1547.09$  total log consumption, minus the harvest of 1409.4 = 137.7 million cubic ft of logs imported to Oregon from other states. Data in the 1992 USFS report may not reflect Oregon's forest products as a whole due to operations who declined to participate in the survey.

In addition, about .08 million cubic feet of firewood<sup>6</sup> is produced, as well as approximately 93.7 million cubic feet of logging residue,<sup>7</sup> at the time of harvest.

	VOLUME (mmcf)	RESIDUE (mmcf)	BARK (mmcf)	JOBS	VALUE ADDED (mm\$)
Forestry Services				4076	
Logging				10197	755.0
Special products mills	0.9	0.5	0.1	194	9.1
Plywood & veneer mill	147.2	181.5	41.4	11458	767.0
Saw & planing mills	374.0	644.7	117.2	15420	1140.1
Post, pole, piling mills	5.4	-	3.9	346	29.5
Pulp mills	*313.0	-	23.2	*	*
<b>TOTAL</b>	<b>840.5</b>	<b>826.7</b>	<b>185.82</b>	<b>41691</b>	<b>2700.7</b>

\*Pulp mill volume total includes: .  
51.2 roundwood chips, 94.4 recovered paper, and 167.4 mmcf mill residue. 218.6 mmcf is actual wood output.

**TABLE B2. Primary industry output, jobs, and value added.**

<sup>6</sup>Volume of firewood derived from Forest Statistics of the United States:1987. Fuelwood averages about 8% of the annual harvest.

<sup>7</sup>Logging residue is derived from 'The 1993 RPA Timber Assessment Update', (Haynes et al. 1993.) Draft version. Residue equals approximately 9.7% of the softwood harvest and 12% of the hardwood harvest. Forest Statistics of the U.S.: 1987 reports a 4% hardwood to softwood ratio in the PNW. Cubic conversion assumes 6 bf /cf.

### Special Products Mills

According to the draft 1992 mill survey, 0.1 percent of log consumption went to shake, shingle and split rail mills, resulting in approximately 1.56 million cubic feet of input. Special product mill output, then, is 0.94 million cubic feet, 0.5 million cubic feet of mill residue and 0.12 million cubic feet of bark. There were 24 establishments in this industry in Oregon in 1992 employing 194 people. Value added in manufacturing from special products mills is estimated to be \$9.1 million.

Payroll and value added were not available directly from the 1987 census due to disclosure. Instead, totals for the industry grouping, SIC 2421 (Sawmills and Planing Mills, general) were subtracted from the major industry grouping, SIC 242 to arrive at the values left in SIC 2426 and SIC 2429. Value added was then derived as mentioned above using the ratio of 1987 value added to payroll and applying it to 1992 payroll reported in 'Oregon Covered Employment and Payroll'. The result is the value added for both industries SIC 2429, (special products mills) and SIC 2426, (hardwood dimension and flooring mills). The ratio of 1992 payroll between these two industries was then used to determine the 1992 value added for each.

### Plywood & Veneer

In 1992, plywood and veneer mills produced approximately 147.2 million cubic feet of product.<sup>8</sup> There were 81 softwood plants and 9 hardwood

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<sup>8</sup>Volume output was 4,308,000,000 square feet of softwood plywood and veneer. Volume of hardwood plywood and veneer was not available. A rough estimate of 400,000,000 sq ft was assumed. A conversion factor of 32 sq feet per cubic foot was used. Both, pers. communication, Craig Adair, Western Wood Products Association - Engineered Wood Products Division.

establishments, employing 10,248 and 1,210 people respectively, for a total of 11,458 jobs in this sector. These industries produced approximately \$767 million in value added manufacturing.<sup>9</sup> Residue from these mills is estimated at 181.5 million cubic feet of mill residue and 41.4 million cubic feet of bark residue.<sup>10</sup>

### Sawmills & Planing Mills

Sawmills and planing mills produced 374.4 million cubic feet of lumber.<sup>11</sup> There are 277 establishments in SIC 2421 (sawmills and planing mills) and 13 establishments in SIC 2426 (hardwood dimension and flooring mills), that together employed 15,420 persons in 1992. Value added by manufacture is estimated at \$1,140.1 million of which \$1,094.7 million was from SIC 2421 and \$45.4 million was produced in SIC 2426.<sup>12</sup> Residue from softwood saw and planing mills is estimated to be 644.7 million cubic feet. This estimate, as noted in the footnote, is based on the US average ratio of residue to output. )regional

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<sup>9</sup>Ratio of 1987 value added, (\$857.2 mill) and 1987 payroll (\$376.2 mill) equals 2.29, multiplied by 1992 payroll (\$336,591,444) = approx. \$766.95 million in value added.

<sup>10</sup>From USFS timber assessment, US avg. of 2.25 cf log required per cf of softwood panel produced and 2.06 cf log per cf of hardwood panel. Bark and mill residues were determined using factors derived from 'Oregon's Forest Products Industry: 1988' (Howard 1991). Residue equals 36.9 cubic feet per 1000 sq ft of 3/8" product produced. Bark equals 8.8 cubic feet per 1000 square feet of 3/8" softwood product produced. Although there are differences in residue between hardwood and softwood all output was assumed to be softwood in determination of residues.

<sup>11</sup>Volume is reported in Western Wood Products Association '1992 Statistical Yearbook of the Western Lumber Industry' (1993), as 6,199 mmbf and includes both softwood and hard wood. Hardwood volume was 93 mmbf. Conversion factor is 16.67 bf per cf for softwood and 12 bf per cf for hardwood based on national avg. used in USFS timber assessment, reported in Briggs (1994).

<sup>12</sup>From 1987 Census of Manufactures, ratio of value added (\$1,062 mill) to payroll (\$455.8 mill) equals 2.33. Applied to 1992 payroll (\$469,848,272) results in \$1094.7 value added for SIC 2421. See explanation for SIC 2429, shake and shingle for calculation of SIC 2426 value added.

averages tend to be much less requiring fewer cubic foot of log to produce the same amount of lumber. Use of the Forest Service 1988 mill survey would lower the residue figure to approximately 440 million cubic feet. Residue from hardwood mills is estimated at 7.7 million cubic feet. Bark is estimated at 117.2 million cubic feet from both hardwood and softwood mills.<sup>13</sup>

#### Poles, Posts & Piling Mills ( Wood Preserving)

This industry produced an estimated 5.4 million cubic feet of treated poles, posts and pilings assuming 9.3 million cubic feet of input. A direct output volume for this industry was not available.<sup>14</sup> Residue and bark are estimated at 3.9 million cubic feet. This industry employed 346 persons in 15 establishments and has a value added in manufacture of \$29.5 million.<sup>15</sup>

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<sup>13</sup>Bark factors from 'Oregon Forest products Industry:1988' (Ward 1991). Bark from softwood reported as 19 cf per mbf produced results in approx. 116 mill. cf of bark. Mill residue factor for hardwood equals approx. 84 cf per mbf or 1.05 dry ton/mbf of lumber produced resulting in 7.3 mill cf of residue. Hardwood bark equals .34 dry ton per mbf lumber produced. Cubic conversion factor of 80 cubic per dry ton results in 2.53 mill tons of bark produced. Mill residue factor of 71 cf/mbf of softwood output reported results in 443.7 mill cf. Compare to residue factor used in this report derived from US avg. used by USFS timber assessment reported in Briggs (1994); Softwood lumber requires 2.76 cf log to produce 1 cf of lumber. Calculation: 366.3 \* 2.76 cf log/cf lumber = 1,010,951,411 cf log to produce (-) 366.3 M cf lumber = 644.7 M cf residue. Hardwood ratio is 2.00 cf log/cf lumber. Calculation; 7.8 M cf lumber \* 2.00 cf log/cf lumber = 15.5 Mcf log (-) 7.8 M cf lumber = 7.7 M cf residue. Total residue: 652.4 M cf.

<sup>14</sup>Volume output was derived based on input and residue factors. The volume input is based on draft version, Oregon Forest Products Industry:1992 (USFS draft) mill survey of .6% of log consumption. This survey is not representative of Oregon as a whole. Residue factor equals 11,000 green tons of hog fuel per 12,504 cunit(100 cf) of barkies (poles) produced for 10 months in 1994; pers. Comm. Bob Gooding, Curtis Pole Plant, Division of Weyerhaeuser. \*Note: also commented that 13% of input is shipped to sawmill. Logs shipped to pole mill in 80'6" - 82' lengths. Defect in first 6" to 2' is used as hog fuel. If defect in first 15', log is not useable for pole but has lumber recovery value. This report assumes input to pole mill is after shipments for defect. Cubic conversion assumes 73 cubic feet per ton bark. Green ton to dry ton conversion; 55%, pers. comm. J. Reeb OSU.

<sup>15</sup>Census of Manufactures 1987 ratio of value added (\$27.2 mill) to payroll (\$9.7 mill) equals 2.8. Applied to 1992 payroll (\$10,548,029) equals \$29,535,212 estimated value added for 1992.

## Pulp Mills

Input volume in pulpwood logs is reported as 77.4 million cubic feet based on percentages from the USFS draft 1992 mill survey. About 30 percent or 23.2 million cubic feet for this is mostly bark residue.<sup>16</sup> Other inputs to pulp mills include recovered paper and residue from other industries. The American Pulpwood Association (APA) reports that 3,040,000 cords of pulpwood and chips were consumed in Oregon in 1992 or 258.4 million cubic feet.<sup>17</sup> American Forest and Pulpwood Association (AFPA)<sup>18</sup> reports recovered paper inputs of 94.2 million cubic feet<sup>19</sup> and wood pulp production of 219.2 million cubic feet.<sup>20</sup> Assuming the same volume of paper is produced from recovered paper as is input (there is a certain amount of waste during this process), and adding to the wood pulp production results in pulp mill output of about 313 million cubic feet. This material is then input into board and paper mills although a minor amount of pulp also goes to wet machine board processes that fall under reconstituted wood products.

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<sup>16</sup>Personal Communication, Brian Greber, Weyerhaeuser.

<sup>17</sup>Cubic conversion: 85 cf/cord.

<sup>18</sup>Personal Communication Mary Magee. AFPA.

<sup>19</sup>Pers. Communication Mary Magee, AFPA, recovered paper for Oregon in 1992 is 1,777,000 short tons. Cubic conversion 80 cubic feet per ton, Pers.comm. Brian Greber, Weyerhaeuser.

<sup>20</sup>Pers. Comm. Mary Magee AFPA, 2,740,000 short tons of wood pulp produced in Oregon in 1992. Cubic conversion 80 cubic feet per ton, pers. comm. B. Greber, Weyerhaeuser.

## Secondary Converting

### Paper & Board Mills

Board production is estimated by the AFPA at 171 million cubic feet and paper production volume was estimated to be 132.9 million cubic feet in 1992<sup>21</sup> for a total estimated output of 303.9 million cubic foot in 1992. These products are direct inputs to the converted board and paper industries as well as reconstituted wood products mills.

	VOLUME (mmcf)	RESIDUE (mmcf)	JOBS	VALUE ADDED (mm\$)
Board & paper mills	303.9	N/Q	*	*
Structural members	34.7	3.2	1520	84.2
Millwork & ktch. cab.	33.9	10.2	9485	383.7
Furniture	N/A	N/Q	1532	66.8
Materials handling	5.6	N/Q	324	10.4
Reconstit. wp	112.6	N/Q	1868	173.3
Convert. board & pape	N/A	N/Q	*8995	*1694.4
Misc. wood products	N/A	N/Q	1100	44.6

**Table B3. Volume output, jobs, value added in secondary industries, 1992. N/A: not available; N/Q: not quantifiable. Converted board and paper figures include all pulp, board and paper.**

<sup>21</sup>Pers. Comm. Mary Magee AFPA reported 1,661,000 short tons of paper production and 2,137,000 short tons of paper board production. Conversion factor 80 cubic feet per ton.

### Paper & Allied Products

All of paper and allied products ( SIC 26), together employed 8,995 persons and produced \$1,694.4 million in value added<sup>22</sup> from manufacture in 66 establishments located in Oregon.

### Reconstituted Wood Products

The reconstituted wood products industry employed 1,868 persons in 19 establishments. Value added in manufacture for this industry is estimated at \$173.3 million.<sup>23</sup> The estimated volume produced in 1992 is approximately 112.6 million cubic feet.

### Structural Members

There were 40 establishments employing 1,520 persons in 1992, producing an estimated \$84.2 million in value added by manufacture.<sup>24</sup> The volume of product output by the structural members industry was approximately

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<sup>22</sup>Census of Manufactures ratio of 1987 value added (\$1,156.6 mill) to payroll (266.6 mill) equals 4.34, applied to 1992 payroll (\$390,556,879) results in \$1,694.4 million value added.

<sup>23</sup>Volume for hardboard and medium density fibre board were derived from mill capacities reported in 1992 Lockwood-Post's Directory of the Pulp, Paper and Allied Trades. Volume reported totals 520 tons daily from four establishment plus 280 Msf 1/8" basis per day and 266 Msf 3/4" basis per day from the two remaining mills. Conversion factors; 1 ton equals 80 cubic feet, 16.8 sf 3/8" basis = 1 cubic ft. Annual total after conversions, 19.83 million cubic feet. Particle board derived from Oregon's Forest Products Industries:1988 Howard and Ward (1991) Assumes same volume production in 1992. Volume reported was 1,159,916 tons dry weight. Conversion factor 1 ton = 80 cubic feet.

<sup>24</sup>From the Census of Manufactures, 1987 ratio of value added (\$66.9 mill) to payroll (\$34.5 mill) equals 1.94, applied to 1992 payroll (\$84,146,837.5) results in \$84.2 million value added.

34.7 million cubic feet.<sup>25</sup> Residue resulting from manufacture was roughly 3.2 million cubic feet.<sup>26</sup>

### Millwork & Kitchen Cabinets

This industry employed 9,485 persons in 211 establishments in 1992. Value added from manufacture of these products is estimated at \$384.6 million.<sup>27</sup> Volume of product output for this industry is estimated at 33.9 million cubic feet.<sup>28</sup>

### Selected Wood Furniture

These industries employed an average of 1,532 persons in 96 establishments in 1992. Value added for this product is estimated at \$66.8 million.<sup>29</sup> Volume of product and residue output for these industries was not quantifiable.

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<sup>25</sup>Volume pers. comm. Craig Adair, American Plywood Association - Engineered Wood Products. Reported 8.3 million cf laminated veneer lumber. Glu- lam beams equal 145 million bf. Conversion factor assumes 16 bf per cf. Reported I-Joists, 119 million lineal feet. Conversion factor is 6.857 lineal ft per cf from George Carter and Affiliates, 767 Park Avenue, Oradell, New Jersey 07649.

<sup>26</sup>Residue volume factor, Pers. comm. Nadine Yingst, Boise Cascade, Boise, Idaho, estimated 1.16 bone dry tons per 1000 cf of output. Assumes 80 cubic foot per bone dry ton.

<sup>27</sup>From Census of Manufactures, ratio of 1987 combined value added (\$263.2 mill) to combined payroll (\$152.5 mill) equals 1.73, applied to 1992 combined payroll of (\$222,337,341) results in estimated value added of \$384.6 million.

<sup>28</sup>Volume derived from 1992 Statistical Yearbook of the Western Lumber Industry. Western Wood Products Association, (1993); reports that 17.7 percent of lumber production output went to structural members and millwork.

<sup>29</sup>From census of manufactures, ratio of 1987 value added (\$102.0 mill)\* to payroll (\$47.9)\* equals 2.13, applied to 1992 payroll (\$31,360,971) results in \$66.8 million in value added. \*Note: 1987 value added and payroll include all of major grouping 25 due to disclosure. 1992 payroll is actual reported.

### Materials Handling

This industry employed an average of 324 persons among 28 establishments in 1992. Value added in manufacture for the material handling industry is estimated at \$10.4 million.<sup>30</sup> The volume of product output is estimated at approximately 5.6 million cubic feet.<sup>31</sup> Residue volume from this industry is relatively small and not measurable.

### Miscellaneous Wood Products

This industry employed 1,100 persons in 99 establishments with a value added estimated at \$44.6 million.<sup>32</sup> Volume in this industry is not measurable.

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<sup>30</sup>From Census of Manufactures, ratio of 1987 value added (\$9.8 mill) to payroll(\$5.7 mill) equals 1.72, applied to 1992 payroll of (\$6,049,728) results in approximately \$10.4 million value added.

<sup>31</sup>Volume for materials handling was derived using ratio of 1986 U.S. volume and value added and applying it to estimated 1992 value added for Oregon. 1986 volume was reported in Analysis of the Timber Situation in the United States, Haynes. (1989). 1986 value added is reported in 1992 Census of Manufactures preliminary industry Series.

<sup>32</sup>From Census of Manufactures, ratio of 1987 value added (\$28.2 mill) to payroll (\$13.9) equals 2.03 applied to 1992 payroll (\$21,959,948) results in estimated 44.6 million in value added.