MASTER'S THESIS

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A STUDY OF SAWMILL CAPACITY & INVESTMENT IN A SELECTED AREA OF THE DOUGLAS FIR REGION OF NORTH AMERICA

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June 14, 1938

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During the month of August, 1931, the sawmills of San Juan, Skagit and Whatcom counties in the State of Washington were visited for the purpose of making a survey of the capacity of the sawmills and the investment made in them. While on the ground other related matters were looked into in order to round out the study and make it as complete as possible for the years 1928, 1929 and 1930.

There were found to be 41 sawmill units in the area selected which is approximately in the north central section of what is known as the Douglas fir region of North America. This part of the region of the Douglas fir is considered fairly typical of the whole and consequently representative of what is to be observed throughout the entire territory although some portions have characteristics differing materially.

The Douglas fir region comprises a land surface between the high Cascade Mountains and the Pacific Ocean. It extends from the southernmost end of Alaska to the highlands in the State of Oregon which separate the Willamette Valley of Oregon from the slopes leading into the Sacramento Valley of California. In the United States it forms the western parts of the States of Oregon and Washington, and in Canada the southwestern portion of the Province of British Columbia.

To supplement this intensive field survey of a selected area and to serve as a check on the observed data, an effort was made to secure a wider sampling by means of a questionnaire sent to the sawmills of the whole region. This was followed by a personal visit to several of the sawmills on the flanks of Mount Rainier. The result of this more extensive work brought in

reports from 22 additional sawmills scattered throughout the Douglas fir region.

Through the cooperation of the West Coast Lumbermen's Association it was possible to study the individual reports on sawmill capacity, inventory, hours operated and quarterly production of all the sawmills in the entire area served by the Association. The Association extends its work well up into Canada so that the Douglas fir region is very completely covered in their data. Confidential reports are received at the Association office from some 350 sawmills. A quarterly field investigation in Western Oregon and Western Washington is conducted by the personnel of the Association staff to round out this data. These representatives secure reports from every individual sawmill operation in that part of the Douglas fir region lying within the United States. The Canadian portion of the Douglas fir region is reported through the Provincial department at Vancouver, British Columbia, to supplement the direct reports received from the British Columbia sawmills by the Association.

From the facts thus assembled have been derived the following observations and conclusions relative to the selected area.

These topics are treated:

1. Sawmill capacity by classes.
2. Ownership control of sawmill capacity.
3. Investment related to sawmill capacity.
4. Efficiency in operating at capacity.
5. Cessation or suspension of operation.
6. Number of years operated or age of mill.
7. Log supply.
8. Equipment.
9. Obsolescence.

10. Extent of manufacture.

11. Productivity per manhour.

12. Primary power per workman.

13. Labor wage.

14. Shipping facilities.

15. Extent of drying.

16. Extent of waste.

17. Species specialization.

18. Hardwood sawmills.

19. Shingle mills.

20. Conclusions.

1. Sawmill capacity by classes:[1]

Class	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Average hourly capacity in M feet BM	Percent of total hourly capacity
1	0 to 3	21	20	1	7
2	3 to 6	6	24	4	8
3	6 to 12	2	21	10	7
4	over 12	12	246	20	78
	Total	41	311	8	100

Less than one third of the total number of sawmills represents almost four-fifths of the total productive capacity. The tendency is even to increase this disproportion. A desire to distribute the overhead burden as much as possible by more nearly continuous operation of the plant results in pressure for two or even three shifts. The small sawmill with low overhead costs is much more responsive to the market conditions and can withdraw from the field entirely for a time with much less loss than a larger sawmill. Unfortunately this elasticity is much more needed at the large unit end of the scale for the withdrawal of a few percent is inappreciable

and is often more than offset by the increased activity of the large units. Thus supply remains stagnant instead of responding with that degree of sensitiveness so necessary to meet the changing intensity of demand of the market.

Note 1. These classes, while arbitrarily chosen, are substantially the same as those used by the West Coast Lumbermen's Association. The slight difference in the number of feet of capacity in each class was found necessary for the convenience of round numbers in changing from a weekly classification basis as used by the Association to an hourly one. The hourly figure makes comparison between the sawmills more accurate without any inquiry as to the difference in the number of hours of weekly operation.

2. Ownership control of sawmill capacity:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number of companies
1	0 to 3	21	20	21
2	3 to 6	6	24	6
3	6 to 12	2	21	2
4	over 12	12	246	8
	Total	41	311	37

In the first three classes the number of operating companies corresponds exactly to the number of sawmills. There is an apparent tendency for the smaller units to be locally managed and to keep their identities. Whatever increase in capacity is required can easily be effected on the same site by additional machinery or increased efficiency. After an operating unit gets into the fourth class there may well be a limit to further effective increase. Then other plants are purchased or a new mill on another site is added.

*See Note 1 under "Sawmill capacity by classes."

One large sawmill company owns three mills in the selected area and a fourth in an adjoining county. This company controls 23% of the total capacity of the area under view in these three mills alone. Another owns three mills with control of 17% of the total capacity. Between them, these two sawmill companies control 40% of the total capacity of the area under view.

A third company owns another large mill on a different log market while a fourth company owns three large pulpwood plants but only the one large sawmill unit.

3. Investment related to sawmill capacity:[2]

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number of** sawmills reporting investment	Percent of number of sawmills
1	0 to 3	21	20	10	48
2	3 to 6	6	24	4	67
3	6 to 12	2	21	2	100
4	over 12	12	246	9	75
Total		41	311	25	61

Total hourly capacity in M feet BM	Percent of total hourly capacity	Total*** investment	Average investment per sawmill	Average investment per M feet BM hourly capacity
11	53	78,400	7,840	7,127
17	69	234,087	58,500	13,770
21	100	770,185	385,000	36,675
192	78	8,547,199	949,689	44,517
241	77	9,629,871	385,195	39,958

Total present**** depreciated value	Average present depreciated value per sawmill	Average present depreciated value per M feet BM hourly capacity	Total***** investment in 1926 dollars
44,325	4,433	4,030	80,977
159,984	39,996	9,411	245,956
420,408	210,204	20,019	758,974
7,181,364	797,929	37,403	12,807,919
7,806,081	312,243	32,390	13,893,826

*See Note 1 under "Sawmill capacity by classes."

**Figures on investment were available for 25 of the 41 sawmills in the selected area, representing 76% of the total capacity.

Average investment per sawmill in 1926 dollars.	Average investment per M feet BM hourly capacity in 1926 dollars	Average present depreciated value per sawmill in 1926 dollars
8,098	7,362	45,782
61,489	14,468	168,096
379,487	36,142	414,288
1,423,102	66,708	10,771,225
535,753	57,651	11,389,391

Average present depreciated value per sawmill in 1926 dollars	Average present depreciated value per M feet BM hourly capacity in 1926 dollars
4,578	4,162
42,024	9,888
207,144	19,728
1,195,692	56,048
455,576	47,259

Note 2. There is no attempt here to classify the sawmills on the extent of manufacture in relation to investment. To make the investment data strictly comparable this should be done for each sawmill. It is believed that the following will be suggestive and informative without the infinite niceties of a more complicated classification to include fabrication.

***The figure given for total investment is the total amount invested in the entire undertaking including logging operations where they are directly tributary to the sawmill and not an independent enterprise. Original cost is used in every case in which it could be ascertained. Cost of replacement, if higher, is sometimes given by business firms as their investment or the figure stated by them as the monetary equivalent may represent capitalized values. In this study it was not possible in every instance to go behind the reported amount to determine its exact origin. Only those figures have been included which seem to be reasonable, taking into account those tangible assets of the company which could be determined by observation at the plant.

****Depreciation, where not reported, is calculated at five per cent per annum for the elapsed time.

*****The index of wholesale prices of the United States Department of Labor is the conversion factor employed. In a number of instances the sawmill has grown by accretion during its whole life up to the present day starting from a very small beginning. It was found impracticable to attempt to isolate each individual outlay. In translating investment into 1926 dollars in such cases, the average of the index numbers over the whole period is used.

A glance at this table is sufficient to account for the tremendous pressure for continuous operation which exists in the large establishment. More than six times the investment per thousand feet of hourly capacity lies between the two extremes.

As a sawmill grows larger, the sawmill company usually finds it necessary or desirable to engage actively in logging with consequent increased capital account. This very increase in capital account tends to cause the directors of the sawmill company to look well to their source of raw materials so that their expensive plant may be assured a continuous and adequate supply of logs. Otherwise a temporary shortage may send the price of logs sky rocketing as the sawmills vie with each other for their raw material. A low, nearly uniform raw material cost level is most desirable. The larger sawmills, therefore, protect themselves by acquiring timber holdings which they can log at their pleasure, either by contract with logging companies or from their own camps.

4. Efficiency in operating at capacity or the extent that operation is conducted at capacity:[3]

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number of** sawmills reporting operation	Percent of number of sawmills
1	0 to 3	21	20	13	62
2	3 to 6	6	24	6	100
3	6 to 12	2	21	1	50
4	over 12	12	246	12	100
Total		41	311	32	78

Total hourly capacity in M feet BM	Percent of total hourly capacity	Three year full capacity production in M feet BM 1928,1929 and 1930	Three year production in M feet BM 1928,'29,'30	Percent of full capacity production
14	72	94,500	22,431	24
24	100	175,500	76,736	44
9	45	67,500	39,328	59
246	100	1,773,000	1,470,875	84
293	94	2,110,500	1,609,370	76

Note 3. One shift of eight hours duration each day at full capacity production for three hundred days per year is considered 100% use of productive facilities in this table.

*See Note 1 under "Sawmill capacity by classes."

**Figures on operation were available for 32 of the 41 sawmills in the selected area, representing 94% of the total capacity.

The larger the sawmill the more nearly the full capacity of the

plant is utilized for productive operations. On the other hand, the smaller sawmill more quickly curtails production in the face of an unfavorable market situation. As indicated in the preceding topic, the large investment in the operating unit induces a tendency toward continuous operation. Inevitably interest and dividend requirements join with overhead expense to exert an irresistible pressure upon boards of directors. The years 1928 to 1930 inclusive were on the whole very unfavorable ones for the lumber industry. A more sensitive response to this situation in curtailed production would have been most desirable. The smaller sawmills met the need in making quick adjustments, the larger ones delayed and consequently prolonged the necessary liquidation process.

5. Cessation or suspension of operation:

Class*	Hourly capacity in M feet BM	Number** of sawmills	Total hourly capacity in M feet BM	Number of sawmills ceasing or suspending operation	Total hourly capacity in M feet BM ceasing or suspending operation	Percent of total hourly capacity in each class
1	0 to 3	28	30	19	20	67
2	3 to 6	7	28	6	23	82
3	6 to 12	4	36	3	25	69
4	over 12	13	259	4	68	26
	Total	52	353	32	136	39

Reason for cessation or suspension of operation	Number of sawmills	Total hourly capacity in M feet BM	Percent of total hourly capacity
Bankrupt	6	27	20
Burned	5	25	19
Shut down indefinitely	15	69	50
Timber supply exhausted	2	10	7
Out of business	4	5	4
	32	136	100

*See Note 1 under "Sawmill capacity by classes."

**In the selected area 11 sawmills were liquidated or destroyed during the period 1928 to 1930 inclusive. These have been included with the 41 sawmills now located in the area under view.

Of course these operations are not necessarily entirely liquidated and lost to the industry. Financial difficulties may be overcome by reorganization and new capital; fire may destroy the plant but rebuilding may start at once on the same or another site; shutdowns, although in this instance indefinite, are usually temporary; timber may be found available elsewhere and persons or companies out of business may reorganize and resume business activity. However, there can be no doubt that some part of these operations may never be resumed although new ones may appear to take their places. The ordinary hazards of business produce the same general result but the inordinate number, almost forty percent of the total hourly capacity, is the reflection of the current depression which has been particularly hard on the lumber industry, already suffering from other more chronic ailments.

6. Number of years operated or age of sawmill:

Year built or acquired	Number of years operated or age of sawmill	Number of* sawmills	Total sawmill years	Total hourly capacity in M feet BM
1930	1	3	3	12
1928	3	2	6	2
1926	5	1	5	5
1923	8	5	40	36
1922	9	2	18	6
1920	11	2	22	8
1918	13	2	26	23
1916	15	1	15	3
1915	16	1	16	1
1913	18	1	18	20
1911	20	2	40	36
1907	24	1	24	4
1906	25	2	50	33
1905	26	1	26	16
1904	27	1	27	15
1901	30	2	60	33
1891	40	1	40	1
1885	46	1	46	2
		31	482	256

*Figures on number of years operated or age of the sawmill were available for 31 of the 41 sawmills in the selected area, representing 82% of the total capacity.

Number of sawmills under same ownership since inception		Total hourly capacity in M feet BM	Number of sawmills changing ownership	Total hourly capacity in M feet BM
1930	3	12		
1928	1	1	1	1
1926	1	5		
1923	3	34	2	2
1922	2	6		
1920	1	4	1	4
1918	1	1	1	22
1916	1	3		
1915	1	1		
1913	1	20		
1911	1	1	1	35
1907			1	4
1906	2	33		
1905	1	16		
1904	1	15		
1901	2	33		
1891	1	1		
1885	1	2		
	24	188	7	68

Although representatives of the major pioneer industry of the Pacific Northwest, most of the sawmills in the area under view are less than two decades old. These sawmills, 22 in number, account for 49% of the total capacity of the selected area.

Several sawmills have been in continuous operation for more than twenty years and two for double that period. The latter have retained several features which mark them as pioneer enterprises. One has a jig saw capable of cutting a thirty-seven inch log and the owner supplies the whole countryside with wagon tongues and reaches. The other still has some of the original wooden pulleys although the jig saw has long since been displaced. This mill had at that time no iron except the saw and power plant. Everything else was wooden and hewn out of native timbers by the father of the present owners.

7 Log supply:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number of sawmills owning timber and percent of class		Total hourly capacity M feet BM
1	0 to 3	21	20	8	38	9
2	3 to 6	6	24	3	50	13
3	6 to 12	2	21	2	100	21
4	over 12	12	246	8	67	178
Total		41	311	21	51	221

Percent of total hourly capacity	Number of sawmills at tidewater	Percent of number of sawmills	Total hourly capacity in M feet BM	Percent of total hourly capacity
43	4	19	6	30
54	1	17	3	13
100	0			
72	9	75	184	75
71	14	34	193	78

*See Note 1 under "Sawmill capacity by classes."

Only slightly more than one fourth of the sawmill capacity of the area under view is non-timber owning and most of this is at tidewater where all the resources of the log market are available. In fact almost four-fifths of the sawmill capacity has the advantage of a tidewater inlet and outlet. The owned timber is largely held in fee simple with the land and mineral rights although in one instance a considerable portion is included in cutting contracts or in the hands of affiliated companies.

Most of the sawmill companies have desired to protect themselves against the vagaries of the open market although wishing to be in a favorable location to be able to tap this great reservoir of supply whenever advantageous. Some of them have not touched their own acreage at all as yet being content to maintain it as an anchor to windward. Some have established camps and are energetically exploiting their holdings in the most approved -- and disapproved -- old time fashion.

8. Equipment:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number of sawmills with jig headsaw	Percent of number of sawmills
1	0 to 3	21	20	1	5
2	3 to 6	6	24		
3	6 to 12	2	21		
4	over 12	12	246		
Total		41	311	1	2

Total hourly capacity in M feet BM	Percent of total hourly capacity	Number with single circular headsaw	Percent of number of sawmills	Total hourly capacity in M feet BM and percent	
0.5	3	11	52	8	38
0.5	0.2	11	27	8	3

Number with circular and top headsaw	Percent	Total hourly capacity and percent		Number with band headsaw and percent		Total hourly capacity in M feet BM and percent	
9	43	12	60				
6	100	24	100				
1	50	9	45	1	50	11	55
2	17	33	13	10	83	213	87
18	44	78	25	11	27	224	72

Number of sawmills with gang saw	Percent of number of sawmills	Total hourly capacity in M feet BM	Percent of total hourly capacity
0			
0			
0			
10	83	203	83
10	24	203	65

*See Note 1 under "Sawmill capacity by classes."

Number with circular or band resaw		Total hourly capacity and percent		Number with edger and percent		Total hourly capacity and percent		Number with slasher and percent	
4	19	5	25	8	38	10	50		
2	33	7	28	6	100	24	100		
2	100	21	100	2	100	21	100	1	50
12	100	246	100	12	100	246	100	8	67
20	49	279	90	28	70	301	97	9	22

Total hourly capacity and percent		Number with automatic trimmer		Total hourly capacity and percent		Number with planer and percent		Total hourly capacity and percent	
						15	71	15	77
						6	100	24	100
11	55	2	100	21	100	2	100	21	100
183	74	10	83	218	89	12	100	246	100
194	62	12	30	239	77	35	85	306	98

In company with other industries, the sawmill has added the automatic machine and multiple tool. Originally all sawing was done on the headsaw and at the cutoff saw. Now this is the practice of only the smallest sawmills. Today the headsaw is largely used to square the material or make one or two flat surfaces. These squares and slabs pass on to the gang, the edger and the resaw and then are cut to length in the automatic trimmer and slasher.

Because of the higher cost of the band saw both in original price and upkeep expense, the industry has been loath to replace its economical circular saws with the more effective band saw. In fact

not one even of the latest construction was found to be using the high speed double-edged band saw. The greater width of the saw kerf and the uneven surface cut by the circular saw as well as its low cutting rate are sufficient reasons why nearly all of the large sawmills representing almost three quarters of the total capacity of the area under view are using the band saw at their head rig.

The planer has become standard equipment in all except the small tie sawmills while the edger is almost as universally included. There is also a widening use of the resaw. Some of the sawmills have a small sidewalk conveyor slasher for cutting short length fuelwood, though lacking the larger one. The automatic trimmer is used almost everywhere as soon as the sawmill has developed a sufficient volume to warrant its introduction. The use of the gang saw seems to be largely restricted to the sawmills cutting a great volume.

9. Obsolescence:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number with obsolete ** machine	& %	Total hourly capacity in M feet BM	& %
1	0 to 3	21	20	5	24	4	19
2	3 to 6	6	24	1	17	3	13
3	6 to 12	2	21	1	50	9	45
4	over 12	12	246	2	17	33	13
Total		41	311	9	22	49	16

*See Note 1 under "Sawmill capacity by classes."

**Circular headsaws are here considered to be obsolete equipment for sawmills whose capacity places them either in class 3 or class 4 and optional equipment in the first two classes.

In the strictest sense all the sawmills in the area under view are suffering from the malady of obsolescence in their methods, machines or plant layout. This table isolates the machine as being the most widely observed criterion and only definitely obsolete machinery is included.

One sawmill in the first capacity group is operating a jig saw.

This same plant and two others use three side planers while two more have very slow planing machines that show the individual cut of each blade on the planed surface. These sawmills are all in the first capacity class.

In the second capacity group, one sawmill has a two side timber sizer. Three of the sawmills of the other two capacity classes use a circular headsaw which for this capacity, over six thousand feet BM per hour, is here considered to be obsolete in view of the efficiency of the band saw in sawmills whose size warrants the higher first cost and maintenance expense.

As was to be expected, the greatest degree of obsolescence is found in the small sawmills whose financial resources have been limited. Organizing with a small initial investment, many of them were forced to begin operations with second hand and often obsolete machinery because of its low first cost. Since that time most of these sawmills have been unable to command sufficient capital to replace this obsolete machinery with modern machines and equipment. Old methods necessarily remain where machinery and layout are obsolete.

10. Extent of manufacture:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number with planers & %		Total hourly capacity in M feet BM & %	
1	0 to 3	21	20	15	71	15	77
2	3 to 6	6	24	6	100	24	100
3	6 to 12	2	21	2	100	21	100
4	over 12	12	246	12	100	246	100
Total		41	311	35	85	306	98

Number with lathmill & %		Total hourly capacity in M feet BM & %		Number with box factory and percent		Total hourly capacity in M feet BM & %		Number and percent with shingle mill, capacity & %			
1	5	2	9	1	5	2	9	1	5	1	6
3	50	11	46					3	50	11	46
1	50	9	45					1	50	9	45
4	33	88	36	6	50	120	49	4	33	72	29
9	22	110	35	7	17	122	39	9	22	93	30

*See Note 1 under "Sawmill capacity by classes."

Six sawmills with a combined hourly capacity of four and a half thousand feet BM carry fabrication only as far as the rough lumber stage. These are in the first capacity group and make up 29% of the number of sawmills in the group and 23% of the group capacity but only 15% of the number of sawmills in all four groups and 2% of the total capacity of all the groups. A little more than one fifth of the sawmills, representing over a third of the total capacity of all the sawmills in the three counties of the selected area have lath making machinery. Some of the largest sawmills have devoted themselves primarily to the manufacture of box shook. There are five of these in the area under view together with two more whose box factory is an important part of their operation.

Among the 21 sawmills of the class one capacity group, one has a shingle machine and another has leased a site close to the sawmill to a shingle company which has built a shingle mill with one machine. The shingle company uses the cedar logs cut on the land of the sawmill company. One sawmill has a lath machine, another makes box shook and still another silo staves. One sawmill makes special material milled to cross section pattern for chicken ranches and special mouldings of any kind. This mill also specializes in "red" fir coupling poles or reaches and wagon and mowing machine tongues of the same species which is found locally in an area the general shape of a half moon south of the Frazer river in the north central part of Whatcom County, Wash.

Of the six sawmills in the class two capacity group, three have lath machines, three have a shingle machine and one has a small dado machine for cutting the dadoes close to the bottom of tank staves. Another sawmill of this group is owned by persons who also operate a sash and door factory at the city where the sawmill output is partially disposed of locally. One sawmill makes shingle bands on its lath machine. In the class three capacity group, one sawmill has a separate shingle mill with several shingle machines. This sawmill

also has a lath mill and includes the making of columns on special order.

In the class four capacity grouping is found 80% of the capacity of the selected area. Six sawmills have large box factories. Five of these confine their operation almost entirely to box shook as their primary objective in production. Four have shingle mills, although the largest, an eighteen shingle machine mill, is leased for operation to a shingle company. Another owns a half interest in a large shingle mill in order to dispose of the low grade cedar logs. One large sawmill company specializes in cedar production exclusively and operates two shingle mills to take care of its low grade logs. Four of the sawmills in this group have a lath mill, although one of these has discontinued the operation of lath making in favor of the cutting of slabs and waste material into bolts for the local pulp mill.

11. Productivity per manhour:

Class*	Hourly capacity in M feet BM	Production** in M feet BM 1928,'29 &'30	Hours	Workers	Manhours	Productivity per manhour in feet BM
1	0 to 3	6,374	4,800	12	57,600	111
2	3 to 6	10,686***	4,200	23	96,600	111
3	6 to 12	39,328	4,656	80	372,480	106
4	over 12	114,230	5,691	154	874,795	131

*See Note 1 under "Sawmill capacity by classes."

**Figures on productivity per manhour are given for one representative sawmill in each class.

***This sawmill found its overrun to average 22%.

The sawmills whose figures are given in this table are considered representative of their class. It is interesting to note that the added size of the sawmill in hourly capacity is so nearly directly proportional to the increased man power, especially in the first three capacity classes. The large sawmills in the class four capacity grouping have been able to add many mechanical devises to assist their man power not practicable in the first three capacity classes so that their productivity per manhour is considerably increased. Volume

production in the sawmill as elsewhere in industry makes possible lowered costs by giving man power the assistance of multiple and automatic machines.

Productivity per manhour is also affected by the efficiency of the sawing operation in reducing a round, tapering log to the greatest possible amount of square cornered material. This produces what is known as overrun, i.e., the increase in the physical volume of production secured by the economical cutting up of the log at the sawmill over what was indicated by the scaling of the log prior to the cutting. At one representative sawmill the overrun was found to average 22%.

12. Primary power per worker:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Total** primary power	Power per M	Workers	Power per worker
1	0 to 3	21	20	1,169	61	75	15
2	3 to 6	6	24	1,395	56	172	8
3	6 to 12	2	21	1,000	111	80	13
4	over 12	12	246	13,350	83	1447	9
Total		41	311	16,914	79	1774	10

*See Note 1 under "Sawmill capacity by classes."

**Figures on primary power were available for 35 of the 41 sawmills in the selected area, representing 68% of the total capacity. Primary power is expressed in the popularly used horsepower units.

By force of necessity the sawmill worker has been plentifully supplied with power on every hand. The very size of the individual logs, especially in the early days of the industry in the Pacific Northwest, forced the introduction of log conveyers or hauling tackle, log turning gear and the steam "nigger" as well as handling cranes and hoists. The old hand controlled circular cutoff saw is still the backbreaker in many establishments but largely the hard labor has been taken out of the plant and even out of the yard where motor carriers and runabouts lighten the loads. Of course this has brought about a great stepping up of productivity.

13. Labor wage:[4]

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Sawmill workers	Common labor **	Skilled labor
1	0 to 3	21	20	77	3.28	4.23
2	3 to 6	6	24	172	2.87	4.93
3	6 to 12	2	21	140	3.25	6.45
4	over 12	12	246	1918	2.91	6.61
	Total	41	311	2307	3.06	5.84

Sawyer	Edgerman	Resawyer	Marker	Filer
4.47		3.75		
5.33	4.00			4.50
8.00	5.75	5.25	4.25	9.00
8.20	5.35	4.42	4.50	11.50
6.21	5.08	4.46	4.38	9.10

Note 4. The data on labor covers the period 1928 to 1930, inclusive, and the wage rates given are the average for an eight hour day. Whereever a rate is not listed in the proper column, the omission indicates that no quotation was received. Figures on labor were available for 39 of the 41 sawmills in the selected area, representing 87% of the total capacity but do not include logging camps.

*See Note 1 under "Sawmill capacity by classes."

**Includes workmen at the sawmill only, not those at the logging camps or engaged in logging. Common labor at the logging camps is on a higher wage level than at the sawmill. Average wage as here used is the arithmatical average of the several wage rates reported and not of the total earnings of all the workmen.

Common labor is often better paid in the small establishment than in the large sawmill. This seems to be due as much to a greater sense of responsibility on the part of the employer who is close to his fellow workers as to the relatively smaller labor supply usually available. In the large enterprise, however, there is opportunity for more division of labor and specialization so that greater skill is developed and a higher wage is consequently the reward of those who are able to adapt themselves to the increased intensity of concentration which is required.

14. Shipping facilities:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Tidewater number of mills	Tidewater capacity	Railway number of mills	Railway capacity	Truck number of mills	Truck capacity
1	0 to 3	21	20	4	6	4	5	13	9
2	3 to 6	6	24	1	3	4	18	1	3
3	6 to 12	2	21			2	21		
4	over 12	12	246	9	184	3	62		
	Total	41	311	14	193	13	106	14	12

*See Note 1 under "Sawmill capacity by classes."

Percent of physical volume shipped over designated carrier:

Class*	Water	Rail	Truck
1	5	21	74
2	2	47	51
3	3	92	5
4	63	35	2

*See Note 1 under "Sawmill capacity by classes."

Most of the small sawmills have moved back from tidewater into the uplands following the frontier of the industry as it has pushed its way farther and farther from the inlets and sounds up the river valleys to the ridges of the high Cascades. Only five in the first three capacity classes remain and fourteen have even left the railway behind. These isolated sawmills necessarily use the motor truck to connect with the nearest rail point or waterway. Six of the first capacity group and two of the second rely entirely upon the motor truck transportation for all of their products while ten more must truck to a railway siding some distance from the sawmill.

The largest sawmills are found where the first logs were cut, partly because of the increment of size mere lapse of time gives to an enterprise in a rapidly developing country and largely because of easy access to the markets of the world through the lumber carrier ships ready to discharge Douglas fir and western red cedar at any port of call.

15. Extent of drying:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number with dry kiln and percent		Total hourly capacity in M feet BM & %	
1	0 to 3	21	20	4	19	5	25
2	3 to 6	6	24	5	83	19	79
3	6 to 12	2	21	2	100	21	100
4	over 12	12	246	10	83	214	87
	Total	41	311	21	51	259	83

Percent of physical volume shipped as designated:

*See Note 1 under "Sawmill capacity by classes."

Class*	Kiln dried	Air dried	Shipped green
1	3	79	18
2	12	80	8
3	20	60	20
4	39	53	8
Total	19	68	13

Slightly more than half of the sawmills have dry kilns for the rapid reduction of the moisture content of their product. These represent 83% of the total capacity of the selected area and are the larger sawmills. Only three of the sawmills of the three larger classes are without the kiln. There is no doubt that the new steam automatic circulating dry kiln is rapidly becoming standard equipment at the sawmill whether large or small. The saving in the time required to bring a piece of wood to a more or less uniform and stable moisture content is very great. Lumber and timber stocks can be graduated to sales requirements, drying sheds and decks are no longer necessary and storage space can be reduced to the minimum required for the closely piled product.

16. Extent of waste:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Number with refuse burner and percent		Total hourly capacity in M feet BM & %	
1	0 to 3	21	20	6	29	6	30
2	3 to 6	6	24	5	83	20	83
3	6 to 12	2	21	1	50	10	48
4	over 12	12	246	12	100	246	100
Total		41	311	24	59	282	90

Number with fuel hog and percent		Total hourly capacity in M feet BM & %		Number with barker and percent		Total hourly capacity in M feet BM & %		Number firing with sawdust & %, total M capacity & %			
				1	16	5	21	15	71	14	70
1	50	11	52					6	100	24	100
								2	100	21	100
4	33	87	35	4	33	92	37	12	100	246	100
5	12	98	31	5	12	97	31	35	85	305	98

*See Note 1 under "Sawmill capacity by classes."

It is standard practice to fire the boilers of the steam power plant or the steam dry kiln with the sawdust and shavings accumulated during the operation of the sawmill and planing mill, any remaining

being sold along with the hogged fuel. Only at the small gasoline tractor operated mill without a steam dry kiln is there an exception and even these sawmills may have a market for this material.

Along with the development of the countryside has grown a demand for fuelwood so that there is now a ready market for the slabwood cut into convenient 12 or 16 inch lengths on the "sidewalk" slasher. Every sawmill in the area under view is marketing some or all of its slabwood in this way. Those sawmills having an appreciable amount of hemlock or spruce slabwood have installed barkers to dress these slabs into bolts acceptable at the pulp mill.

The last few years have brought the introduction of the hog for shredding the small strips, short pieces and bark into what is known as hogged fuel and this new material is finding a market in house and factory. These outlets for what was originally largely waste material have left little but barnacles for the refuse burner. One of the newest sawmills having a capacity of over 11 thousand feet BM per hour is entirely without this old waster rolling out smoke and valuable distillates to the sky. Like the packing plant which uses everything but the pig's squeal, this sawmill accounts for every scrap and shred of the log.

17. Species specialization:

Class*	Hourly capacity in M feet BM	Number of sawmills	Total hourly capacity in M feet BM	Percent of production Douglas fir	Number of sawmills and capacity total in M feet BM & %			
1	0 to 3	21	20	93	21	100	20	100
2	3 to 6	6	24	81	6	100	24	100
3	6 to 12	2	21	65	2	100	21	100
4	over 12	12	246	37	8	67	178	72
Total		41	311	69	37	90	243	78

Percent of product western red cedar	Number of sawmills and capacity total in M feet BM & %				Percent of product western hemlock	Number of sawmills and total hourly capacity in M feet BM with percent of each			
5	5	24	6	30	1	3	14	4	20
6	5	83	19	79	13	6	100	24	100
15	2	100	21	100	20	2	100	21	100
15	6	50	129	52	38	11	92	231	94
10	18	44	175	56	18	22	54	280	90

Percent of production in sitka spruce	Number of sawmills and percent		Total hourly capacity in M feet BM and percent	
1	1	5	2	10
0				
0				
10	7	58	151	61
3	8	20	153	49

*See Note 1 under 'Sawmill capacity by classes."

The sawmills whose production is largely fabricated into box shook mainly confine their cut to hemlock and spruce with some Douglas fir, larch and cottonwood. There are five of these and all are of the class four capacity group. They have a combined capacity of 78 thousand feet BM per hour. The cut of this group averages 72% western hemlock, 22% sitka spruce, 3% Douglas fir, 2% larch and 1% cottonwood. One of the small sawmills which makes some box shook also adds the white fir and another includes a very little white pine.

All of the sawmills in the first, second and third capacity classes center their production in the main on Douglas fir. They have a combined capacity of 65 thousand feet BM per hour. Their cut averages 80% of this species with 9% cedar, 11% hemlock and a bit of spruce. One of the largest sawmills specializes entirely on western red cedar. It has an hourly capacity of 15 thousand feet BM of cedar lumber and 9 thousand feet BM in cedar shingles or a total of 24 thousand feet BM per hour. One small sawmill is located in the half moon shaped area bulging south from the Frazer river where the red fir is found. This sawmill has a reputation for the sturdiness of its red fir wagon reaches and tongues covering more that forty years.

18. Hardwood sawmills:

Class*	Hourly capacity in M feet BM	Number of softwood sawmills	Total hourly capacity in M feet BM	Hardwood mills and percent of all sawmills		Capacity and percent of all sawmills	
1	0 to 3	21	20	4	4	4	17
2	3 to 6	6	24				
3	6 to 12	2	21				
4	over 12	12	246				
Total		41	311	4	9	4	1

*See Note 1 under "Sawmill capacity by classes."

Alder, birch and maple, together with a little spruce and cottonwood are in demand for furniture manufacturing. Several hardwood sawmills have been built in the last few years to cut these species which have long been established in burned areas or along river bottoms and more lately on cutover lands. There are four of these hardwood sawmills in the selected area. The largest has an hourly capacity of 2 thousand feet BM and the four have a total capacity of a little more than 4 thousand feet BM per hour. The two largest have dry kilns and cut up plants although all four ship rough air dried material. Three of the sawmills operate with electric power while the smallest one, located in the hinterland far from a source of power, is perforce using gasoline. One has a band headsaw but the others use a circular head rig. The four hardwood sawmill companies have a total available log supply covering 55 years at full capacity production or an average of nearly 15 years for each sawmill.

These four hardwood sawmills have 35 workers assisted by 713 horsepower or an average of 20 horsepower per workman. Production per hour is 4,250 feet BM or a productivity per manhour of a little more than 121 feet BM. Rates of wages for common labor during the period 1928 to 1930, inclusive, varied from $3.00 to $4.00 per eight hour day with an average for the four sawmills of $3.30 for eight hours work. The total investment as reported amounts to $99,100** which converted to the 1926 dollar equals $113,889 or an average investment per sawmill of $28,472 of 1926 value and for each thousand feet BM in capacity an investment of $26,797 in the same 1926 unit of value. The two larger hardwood sawmills have direct rail connection, while the two smaller must depend on trucking to rail or water or destination. Sawdust goes to the kiln boilers and one sawmill hogs its slabs and small trimmings for the same purpose. Chicken ranchers favor the hardwood sawdust on roosting platforms since it adds potash

to the resulting fertilizer. Slabwood is also sold for fuel. The use of this material in smoking meats and fish has not as yet been developed.

**See the notes under "Investment related to sawmill capacity."

19. Shingle sawmills:

Class*	Hourly capacity in M feet BM	Number of softwood sawmills	Total hourly capacity in M feet BM	Number of shingle mills and** total hourly capacity in M feet BM with percent of each in relation to softwood mills			
1	0 to 3	21	20	24	114	23	115
2	3 to 6	6	24	3	50	10	42
3	6 to 12	2	21	2	100	13	62
4	over 12	12	246				
Total		41	311	29	71	46	15

Number of shingle mills at tidewater and percent		Total hourly capacity in M feet & %		Inland shingle mills and percent		Total hourly capacity in M feet BM and percent	
10	42	13	57	14	58	10	43
2	67	7	70	1	33	3	30
1	50	6	46	1	50	7	54
13	45	26	57	16	55	20	43

*See Note 1 under "Sawmill capacity by classes."

**Ten of these shingle mills are owned by softwood sawmills and are an integral part of their operation: the other nineteen are individual enterprises. The ownership of the former is distributed as follows:- one is owned by a sawmill of the first capacity class, three are owned, respectively one to each, by three sawmills of the second capacity class, one is owned by a sawmill in class three and five are owned by four sawmills of the fourth class, one of which, an exclusively cedar lumber and timber producing sawmill, owns two shingle mills, and the other four sawmills each owning one shingle mill.

From earliest times it has been customary to fabricate the low grade cedar logs into shingles. Most of the shingle mills are small and located close to areas being logged or at tidewater where water borne rafts of logs can be towed from the concentration points in the local log market. There are 29 shingle mills in the selected area with a total hourly capacity of 46 thousand feet BM. Ten of these representing 52% of this capacity, namely 24 thousand feet BM are an integral part of a sawmill operation. The other nineteen are entirely individual and distinct enterprises and have an hourly

capacity of 22 thousand feet BM or 48% of the total capacity of the area. Five of the latter are individually organized on an internal cooperative basis. They are in the first capacity class with a total hourly capacity of 10 thousand feet BM and represent 43% of the total capacity of their class and 22% of the total capacity of all the shingle mills in the area under view. Two of these five cooperatives own their plants: one wholly, the other on a purchase contract. One hundred thirty-four persons are associated in these cooperatives.

Only five of the smallest shingle mills with a total hourly capacity of two thousand feet BM and representing 4% of the total shingle making capacity of the area are without steam dry kilns for rapidly bringing their product to the minimum moisture content and therefore the minimum weight for shipment. Four shingle mills operate with electric power. The total capacity of these electrically operated shingle mills is 5 thousand feet BM per hour or 11% of the total capacity of the selected area. The remaining 25 shingle mills with 41 thousand feet BM hourly capacity or 89% of the shingle producing capacity use steam power plants fired with their accumulated sawdust which is also used for the kiln boilers.

Thirteen shingle mills representing 33% of the capacity of the area under view have a total of 1,393 horsepower for the assistance of their 211 workers or 6.6 horsepower per workman. These are all in the first capacity group with a total capacity of 15 thousand feet BM per hour. In fourteen shingle mills representing 37% of the total capacity of the selected area, there were found to be 45 shingle machines and 226 workmen or an average of 5 persons to each shingle making machine. These shingle mills are all in the first capacity class and have a total hourly capacity of 17 thousand feet BM. The productivity per manhour of this group of shingle machines is 75 feet BM or 750 shingles or three bundles of shingles with 250 shingles in each bundle.

20. Summary, conclusions and recommendations:

Some 29% of the sawmills in the selected area have the lion's share of the productive capacity, in fact 79%, and the tendency seems to be in the direction of even greater concentration of the industry into the hands of a few large units. These large units have a tendency to operate 2 and sometimes 3 shifts in order to spread their expanded overhead more thinly so that practically this disproportion is greatly increased. Because of their very size these sawmill companies are much less responsive to market conditions than the smaller organization so that there is less elasticity in expansion and contraction of output. This lag in meeting the markets changing demand intensifies irregularities and disrupts the orderly merchanding of the product.

The small sawmill is usually locally owned and managed and tends gradually to increase in size ultimately acquiring or building other sawmill units. Five companies in the area under view have one or more additional plants utilizing wood as a basic raw material and seven have acquired or organized a separate retailing department or organization to exploit their local market more effectively. Two sawmill companies have reached such proportions that one of them controls nearly one quarter of the total capacity of the area and the other about one sixth so that between them these two companies possess 40% of the capacity of the area under view.

Increased output and extensions and refinements of fabrication require additional investment in working capital, machinery and plant and frequently in the sources of raw material where necessary to assure an adequate and certain log supply. Measured in 1926 dollars the invested capital in the average small sawmill of not more than 3 thousand feet BM hourly capacity is only one ninth as much per thousand feet BM hourly capacity as the large sawmill of over 12 thousand feet

BM hourly capacity. Heavy investments bring about a great pressure for continuous operation of the income producing facilities in order to meet the demands of the capital account.

In spite of an unfavorable market situation in the industry over much of the period 1928 to 1930, inclusive, the large sawmill operated only 16% less than full capacity production while the small sawmill was curtailing production more than three quarters. The net result was that the production of the sawmills in the selected area was maintained at slightly more than three quarters of full capacity for the interval. The small sawmill bore the brunt of this retrenchment.

By the end of 1930, 39% of the sawmill capacity at the beginning of the period, January 1, 1928, had ceased or indefinitely suspended operations. Nearly a fifth of this prostrate capacity had burned, another fifth was bankrupt, half was shut down and the remaining 11% had exhausted their available timber supply or gone out of business. The every day casualty list of business includes all of these but economic disorders outside the lumber industry had added their toll.

Two sawmills have been in continuous operation for more than 40 years but most of the sawmills are less than two decades old and the rest have operated less than thirty years. Although a pioneer industry, lumber production in the Douglas fir region is still very young and has many of the problems of its adolescence yet to work out such as follow from too rapid growth and extension of activities.

About 71% of the sawmill capacity in the selected area have timber holdings and most of the remaining sawmill capacity is at tidewater where the log raft is always available to anyone for the going price ruling the log market at the moment. In fact nearly four-fifths of the capacity of the area is situated at tidewater assuring a log supply as long as the Douglas fir is exploited for market.

The automatic machine and multiple tool are a recognised part of the modern sawmill's equipment. The band headsaw has come into wide use in the larger sawmills and also the gang saw, the resaw and the automatic trimmer. The planer, too, has been developed to the point where skill is transfered to the machine and only an operator pressing buttons is now required to produce the most perfect results in finished materials and mouldings. These advances have left many sawmills with equipment which is now definitely obsolete. Sixteen percent of the capacity of the area under view have one or more of these obsolete machines and others have handicaps in old methods or an awkward layout. The small sawmill is the more cramped because of its inability to command sufficient capital in a declining market to effect the required changes.

Only two percent of the sawmill capacity confine their manufacturing to rough lumber and timber. The remaining 98% include surfacing and moulding to any cross section pattern. In addition to these activities 35% of the sawmill capacity make lath, 39% box shook and 30% shingles.

In the smaller sawmills productivity per manhour averages 109 feet BM and capacity is directly proportional to the number of workmen required fully to man the plant. The increase in physical volume of production in the larger sawmill is effected by the addition of the multiple tool and automatic machine. This assisted man power is able to increase its productivity per manhour to 131 feet BM. Efficiency in cutting up the log or overrun also affects productivity per manhour. The average primary power per thousand feet of hourly capacity is 79 horsepower. This plentitude of power has been largely responsible for the greatly increased productivity of the sawmill in the Pacific Northwest where the immense size of many of the logs makes mechanical handling devices imperative. An average of 10 horsepower assists each workman.

Rates of pay for an eight hour day run from a low of $2.35 to a high of $12.00. Transfer of skill from the worker to the automatic machine and multiple tool and division of labor have brought this wide separation of the two extremes. Many more tasks can now be allotted to what is known as common labor and the machine operator is but a little higher in the scale. However, a certain few workers of high skill very intensively applied result from this specialization made possible by increased volume of production.

The pioneer moved on when the smoke of a neighbor's hearth reached his nostrils. True to the frontier instinct, the small sawmill has largely kept in the outer fringe of the exploitation of a commonwealth. Some 62% of their number or more than one third of the total number of sawmills in the area have no direct rail or water transportation and must rely on the motor truck. The largest sawmills are at tidewater in three quarters of their number and of their capacity as well. The shipments of the latter from the area under view are nearly two-thirds by water, more than a third by rail and about 2% by truck.

Much less lumber than formerly was the practice is now being shipped in a green condition. Steam drying kilns are almost universally used in all but the smallest sawmills resulting in prompt shipment of special orders, smaller lumber and timber stocks, and less shed and deck space devoted to drying.

Originally slabs and sawdust were in part burned under the boilers and the balance conveyed to the waste heap or incinerator. With the settlement of the arable lands came a demand for fuelwood and more lately for sawdust or hogged fuel. Paper making now claims the spruce and hemlock slabs. In consequence less and less of the waste in kerf and slabs and short ends is unreclaimed.

Douglas fir is the predominant species in the selected area

and gives its name to the whole region. Most of the sawmills are exploiting the Douglas fir with a limited cut of any other species which may be found in the same habitat with it. However at tidewater species specialization is convenient and often feasible. The box shook manufacturers want hemlock and spruce largely. The western red cedar sawmill is an appreciable factor in disposing of the better grades of that species which is so often associated with the Douglas fir.

The hardwood sawmill is a recent initiate in the Douglas fir region. Alder, birch and maple find the river bottoms and stream banks to their liking as well as old burns and more recently the more fertile and well-watered cutover lands. All these species are receiving attention for furniture manufacturing, and cottonwood and some spruce as well.

The shingle sawmill exploits the low grade cedar logs. It is often the first to establish itself in a new area. There are 29 shingle mills in the selected area with a total hourly capacity of 46 thousand feet BM, or 460 thousand shingles per hour.

Now that the timber is largely found in the uplands a long rail or truck haul from tidewater there would seem to be no reason why a decentralization of the industry should not take place bringing great economy in handling and transportation. Modern steam turbine electric sawmills of varying capacity might be located at the opening of valleys with tributary areas sloping in from several stream forks. Here the lower grade logs could be fabricated, the better grades squared and the latter sent with the peelers to tidewater sawmills and veneer plants specializing in the different species. There to be remanufactured for the thousand and one uses society has found for wood.

The large sawmill company is in a position to inaugurate

such a program but the small company needs the support of his fellows. Sawmill companies of small proporations might well form a marketing association. The timber growers might organize as have the raisin growers of California. Internal cooperation has already come in the shingle sawmill. We may now look for cooperative associations of two or more shingle sawmills and perhaps sawmills as well. The small sawmill should find some remanufacturing speciality which it can develop -- perhaps in association with one or more of its neighbors. It should also abandon the attempt to fill any and all orders and gear its production to meet a selected portion of the business in which it can then become known as specializing.

For many years to come large supplies of old timber will continue to come upon the market. Fortunately the owners of this timber are beginning to practice economic selection so that we may expect the future to hold much more promise of an ultimate sustained yield program of forest management. The "mining" of timber under a liquidation program is and must be at an end for we have no other northwest for future exploitation. The era of unappropriated, so called "free" lands has passed with the disappearance of the frontier and now we must necessarily turn to integrated land use for our forests as well as for intensively cultivated agricultural lands or densely populated urban centers.

By the acquisition of suitable second growth and regenerated cutover areas many sawmill companies could follow the development toward sustained yield, particularly those up from tidewater. Even the tidewater mill might well thereby become independent of the vagaries of the log market although always tapping that reservoir when favorable. Our declining demand is not a chronic condition precluding any such ambition for the future. Housing conditions alone are a sufficient potential demand and with the resolving of the prefabricated

unit construction design, a latent upswing should find the industry on an even better footing to meet the need.

To be ready the small sawmill should relinquish its present liquidation orientation and amend its policy toward continuing existence through operation under sustained yield. It should modernize the whole sawmill and woods operation in minute detail. It should become /known as being highly skilled if in nothing more than superior quality of fabrication.

The larger plant may find it desirable to experiment over a period of years to find its greatest operating efficiency. It may need to stabilize its markets although some business must be foregone. It may have to improve its financial position even to the point of drastic reorganization.