



Productivity Measures Are Often Misunderstood: Container Crane Moves per Hour? Cost per Move? Cargo Moved per Unit of Labor?

On the Container Terminal

When productivity is discussed in the container industry, people frequently refer to the number of container moves made on and off of a vessel in an hour, or in a shift, by a ship-to-shore gantry crane. Thus, comparisons are often made between ports or between container terminal operators on the basis of the number of moves per hour.

What do such numbers as 24 or 30 moves per hour really tell about container productivity on a terminal or in a port? Probably not a great deal. A slow crane will certainly reduce container terminal productivity, and a large number of lifts per hour supports a higher level of terminal productivity. Very high numbers of lifts per crane hour are probably being measured, however, under the most ideal and unsustainable conditions.

The table to the right demonstrates how misleading it can be to judge productivity based only on the number of moves made by cranes. The example shows how various measures of terminal productivity may vary enormously when crane production stays the same.

Suppose that two different terminal operators, Terminal X and Terminal Y, have the same type of cranes and equally skilled crane drivers. They each average 28 lifts per hour on a shift against the same vessel. If each operator runs two cranes against the vessel, then the pair of crane drivers at each terminal will make 448 lifts in an eight-hour

Lifts per Hour Affect Productivity but Do Not Measure It				
	Terminal X	Terminal Y	Terminal Z	
Crane Activity				
Lifts per Crane Hour	28	28	18	
Number of Cranes	2	2	2	
Total Moves per Shift	448	448	288	
Manning, Hours, Wages				
Manning against Vessel	30	57	30	
Total Hours Paid	261	514	261	
Total Direct Wage Costs	\$7,848	\$15,947	\$7,848	
Productivity Measures				
Moves per Hour Paid	1.72	0.87	1.10	
Moves per Employee	14.90	7.86	9.60	
Cost per Move	\$17.52	\$35.60	\$27.25	

shift. However, Terminal X has a total of 30 employees working against the ship while Terminal Y has hired 57 for the same operation. Terminal X's labor cost is \$7,848 for the shift for 261 hours paid, but Terminal Y's labor bill is over twice that amount.

The cost per move on these terminals is vastly different. In fact, Terminal X is expending \$17.52 per lift, and Terminal Y is paying \$35.60 per lift, more than twice as much. Although both operators maintain the same average of 28 lifts per hour, Terminal X is producing twice as many moves for each dollar of labor cost. The addition of extra employees by Terminal Y has brought its cost per box to a very high level compared to Terminal X, putting it at a competitive disadvantage.

Terminal Z, on the other hand, has hired the same number of employees on its operation as did Terminal X, but Terminal Z has a slower operation and moves only 18 boxes per hour. The two crane operators at Terminal Z together make 288 moves in a shift. The direct wage cost for Terminal Z is the same as that of Terminal X, but the cost per move is \$27.25, almost \$10 more.

Many measures of productivity on the container terminal can be calculated and compared. The example shows several pos-

sible candidates, such as "moves per crane hour," "moves per hour paid," "labor cost per move." Others might include "trucks per gate per shift," "truck volume per gate per clerk hour paid" or "lifts per shift on and off rail cars."

What is Productivity?

The term *productivity* commonly refers to "the rate at which goods or services are produced." The "service" provided by marine cargo terminals is the movement of cargo. The "rate" of production can refer to "the amount of cargo moved per unit of labor" or to "the cost for movement per unit of cargo." In the example, above, the measures of moves per hour paid and cost per move provide more information about the productivity of the operation than the lifts per crane hour.

PMA has traditionally measured and published productivity data for the U.S. West Coast longshore industry as tons of revenue-producing cargo per hour of labor paid for its movement. These measures of productivity include all assessable cargo reported moving through West Coast ports and the total longshore and clerk hours paid in connection with its movement.

Figure 1 on the next page shows productivity measured annually for each con-

CONSUMER PRICE INDEX U.S. CITY AVERAGE - ALL ITEMS (1982-84 = 100)

Urban Wage Earners & Clerical Workers

Month	1997	1998	1999	12 Mo.
JAN	156.3	158.4	161.0	1.64
FEB	156.8	158.5	161.1	1.64
MAR	157.0	158.7	161.4	1.70
APR	157.2	159.1		1.21
MAY	157.2	159.5		1.46
JUN	157.4	159.7		1.46
JUL	157.5	159.8		1.46
AUG	157.8	160.0		1.39
SEP	158.3	160.2		1.20
OCT	158.5	160.6		1.32
NOV	158.5	160.7		1.39
DEC	158.2	160.7		1.58

tract year since 1980/81. Each value is calculated by dividing the number of weighted tons of revenue cargo moved across the Coast in twelve months by the total number of longshore and clerk hours paid in that same contract year.

For the thirteen years between 1980/81 and 1993/94, productivity grew consistently from 3.3 tons per hour paid to 8.7 tons per hour. A straight line fits the data very well; that is, very well until 1994/95.

Improved Measures

Efforts have been made to refine this measure by removing from the hours data certain types of labor. For example, hours paid at mechanics, planners, and grain elevator payroll occupation codes have been excluded. Decreasing the hours used in the calculation has the effect of increasing the productivity measure somewhat.

A weighting factor has also been applied to the Automobiles & Trucks tonnage category as well as the factor traditionally applied to Bulk Cargo. (See discussion, page 63, *1998 PMA Annual Report*.) This additional weighting slightly reduces the calculated productivity values.

The resulting data are depicted in the Figure 2. The refinements produce productivity numbers that are consistently above those that were calculated without the refinements, but the trend is still essentially the same. (The plots from Fig. 1 are shown in gray in Fig. 2 for easy comparison.)

Productivity rose regularly until the 1993/96 contract during which it began to decline. If the straight-line trend seen for many years had continued, the West Coast would be enjoying productivity of nearly 12 weighted tons per hour paid instead of the 9.5 value experienced so far this year.

Empties, etc.

The argument has been made that these measures, which include only "revenue producing" cargo, ignores the large numbers of empty containers being handled on the West Coast in the past couple of years. PMA has collected data on empty containers since 1993, and Figure 3 includes productivity calculations with those containers added to the weighted tonnage.

The plot of this productivity calculation is shown in comparison to the two sets of data from the charts above. The black trend line drawn is parallel to that of the refined measures already described. The tonnage used in this calculation includes all containers, and they are weighted at 17 tons per TEU whether full or empty.

The difference here is that the decrease in productivity seen in the other two sets of calculations has been transformed into a flat line. These data all describe productivity that has stagnated since late 1994.

Figure 1. Wtd. Revenue Producing Tons per L/S & Clerk Hour Paid By Contract Year: 1980/81 - 1998/99 (to date)

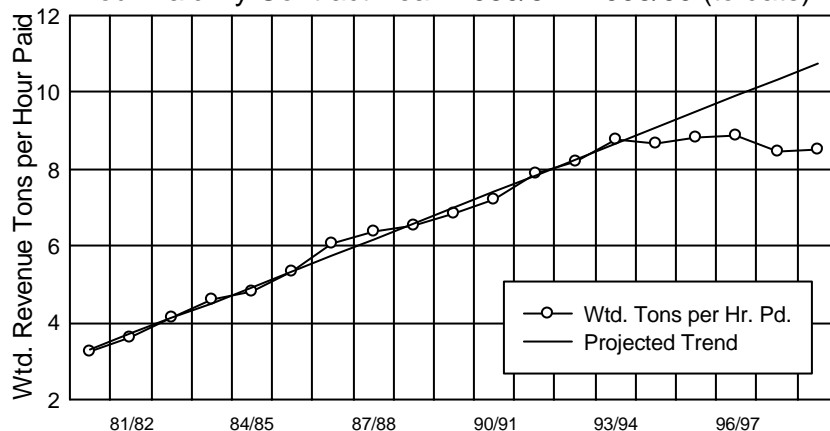


Figure 2. Excluding Specific Occupation Codes and Including weighting factor for Automobiles & Trucks

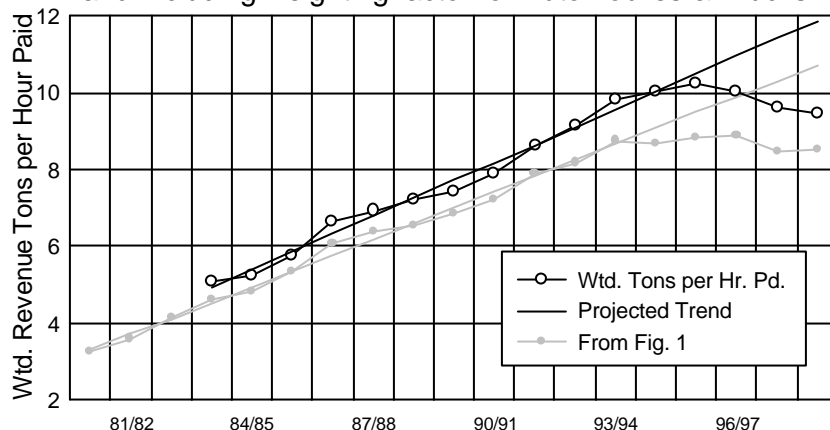
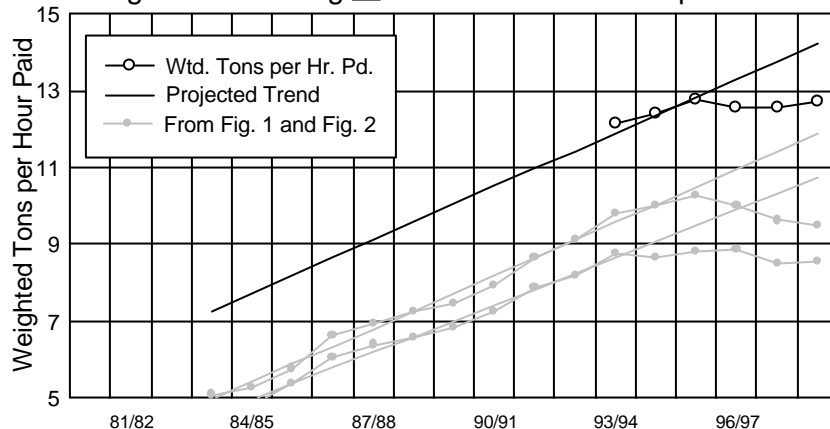


Figure 3. Including all Containers at 17 tons per TEU



Planned Improvements for Measuring

Looking to the future, PMA is currently expanding data collection in the payroll and tonnage systems to measure productivity with more precision and to publish many other useful measures. This project is expected to be completed and implemented this fall. Plans are underway to publish specific productivity information by cargo sector and to determine productivity changes that occur against the vessel, in the yard, against rail, and truck volume processed through the terminal gates.

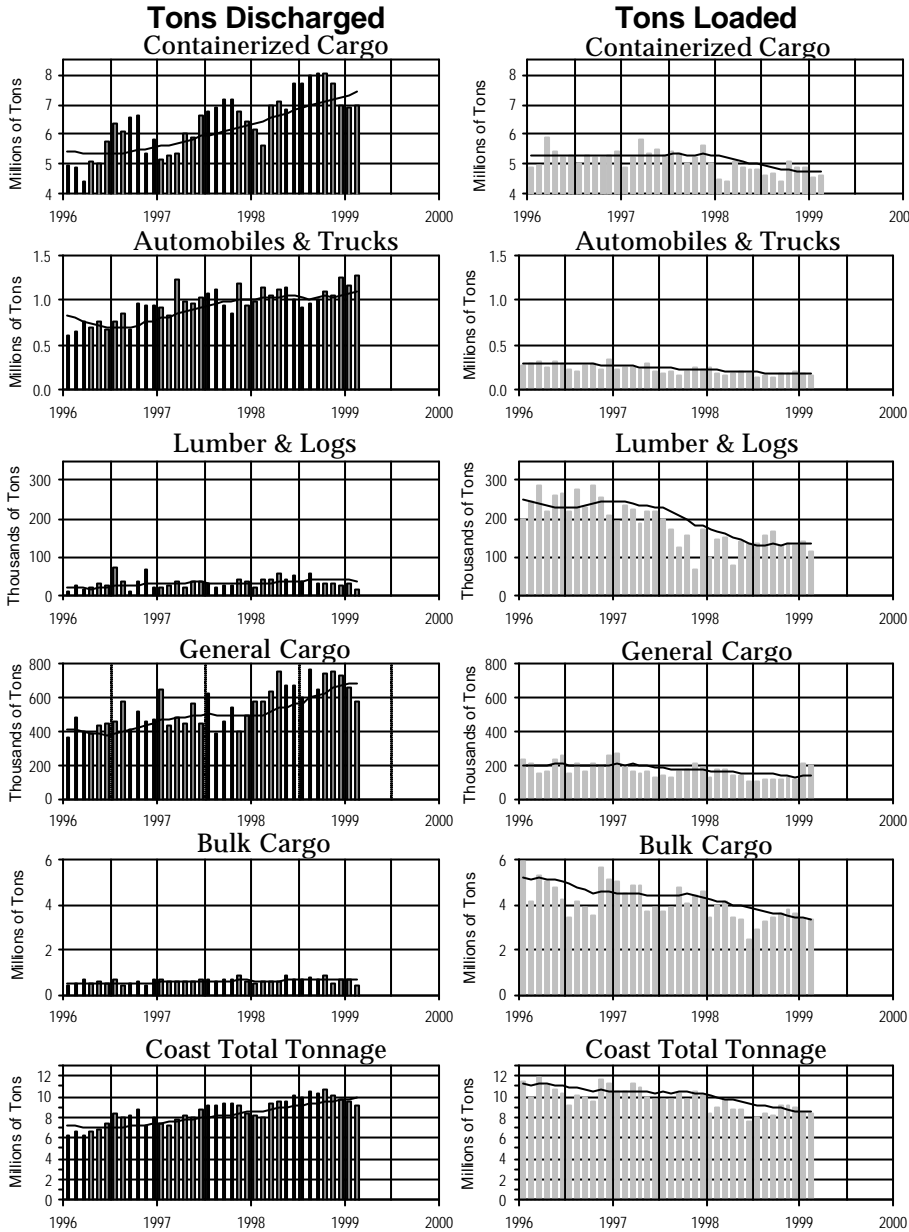
Crane Production vs. Productivity

The most important point is that unlike the number of moves per hour made by ship-to-shore gantry cranes, the productivity data provided by PMA measures the overall hours and cost of labor required to move a unit of cargo.

Furthermore, this rate has not increased in the past few years despite the additional investments made by port authorities, by terminal operators, by shipping lines, and the additional wages paid to the longshore work forces.

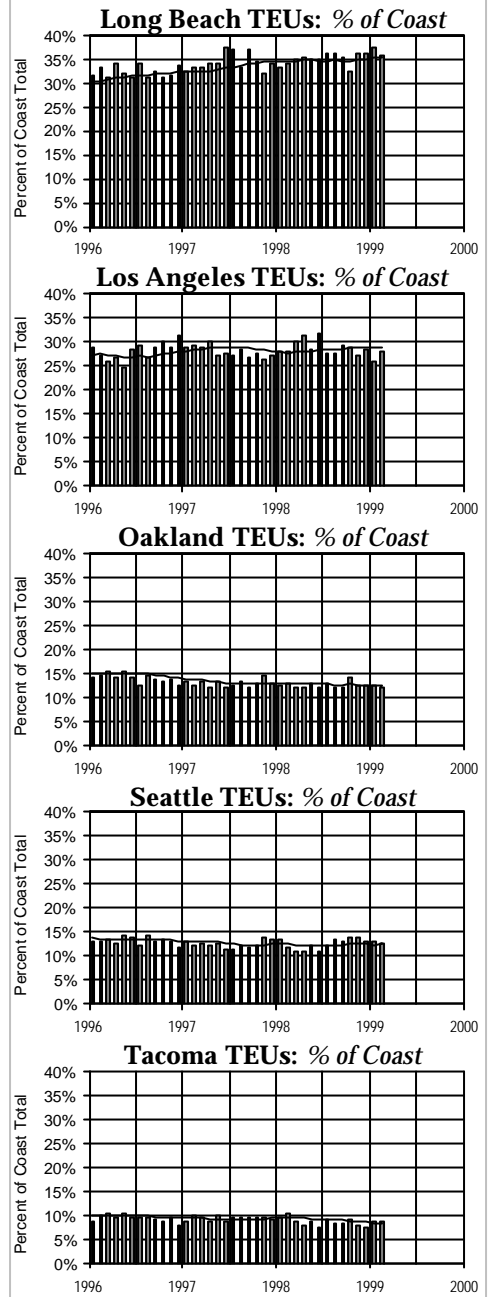
Monthly Tonnage by Reporting Category: Discharged vs. Loaded

Actual Tons Reported by Month



In the Tonnage graphs above, bars represent monthly totals, and the lines show 12-month moving averages.

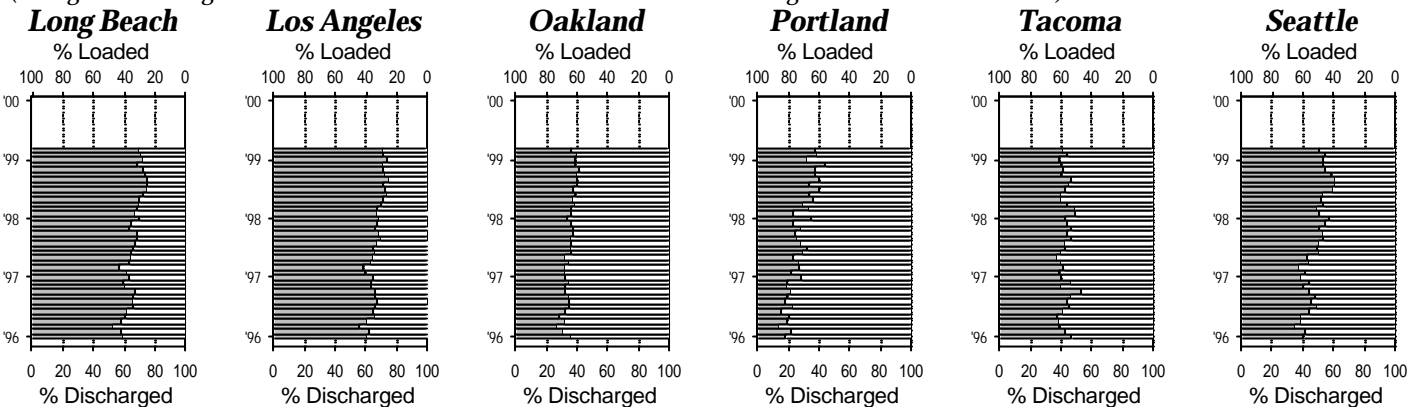
Major Container Ports: Percent of Coast Total TEUs



"Weighted" Tonnage: % Discharged vs. % Loaded

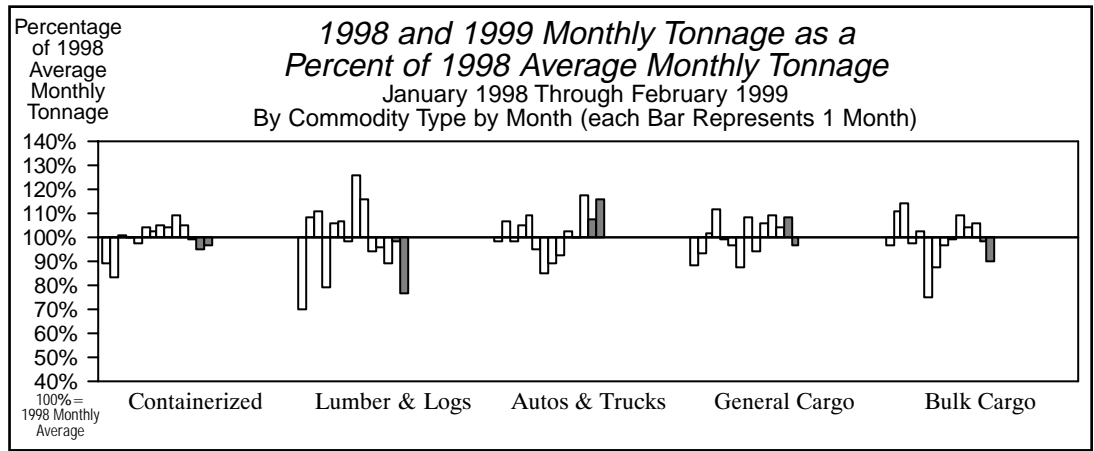
("Weighted" Tonnage = Containerized + 1/6 of Autos & Trucks + Lumber & Logs + General + 1/50 of Bulk)

% Discharged % Loaded



ILWU LOCAL/PORT AREA	REGISTRATION		STATS (For 52 Payroll Weeks)							PORT HOURS (Year-to-date)					TONNAGE BY PORT AREA (For 12 months-to-date & YTD)									
	(At 4/8/99)		(Ending 4/3/99)		Hours Paid:					Hours Paid at					% of Category Coast Total (12 Months-to-Date)					% of 1999 YTD				
	TOTAL	Class "B"	Number Working	Annual Hrs Pd	Wkly PGP	Out of Port	Other Local	Cas-uals	Inact-ives	P/R Wks 1-14, '99	Avg. Wkly % Cst	Occ Codes Ck	Frm	Exp. Rates*	Cont'r RU's	Lmbr Logs	Autos Trucks	Other Gen'l	Bulk Cargo	TOTAL	1999 YTD (Jan-Feb)	% of Coast Total	'99 as a % of '98	Cstwise Loaded
NO.	NO.	NO.	HRS	\$	%	%	%	%	HRS	%	%	%	%	%	%	%	%	%	%	TONS	%	%	TONS	
Longshorem																								
Southern California																								
29 San Diego	54	20	51	2,237	1	7.5	4.6	32.6	0.4	3,222	0.8	9.1	12.1	27.3	<0.1	3.6	12.8	1.4	2.0	1.4	643,551	1.8	134.9	0
13 Los Angeles/Long Beach	4,031	1,048	3,985	2,019	<1	0.2	1.2	9.3	0.4	232,072	58.2	24.7	9.9	17.8	64.1	7.7	35.1	51.9	27.3	53.0	18,051,899	50.9	111.2	14,714
46 Port Hueneme	82	12	79	2,064	<1	6.9	5.8	38.1	0.3	6,635	1.7	14.2	6.4	32.3	0.1	<0.1	10.5	7.4	0.1	1.1	389,365	1.1	101.1	0
Southern California Total	4,167	1,080	4,115	2,023	<1	0.4	1.3	10.4	0.4	241,929	60.6	24.2	9.8	18.3	64.2	11.3	58.4	60.7	29.4	55.6	19,084,815	53.8	111.6	14,714
Northern California																								
10 San Francisco Bay Area	1,033	204	984	1,693	<1	1.8	1.8	4.5	0.6	48,091	12.1	26.8	8.0	18.0	12.7	0.1	5.9	8.5	2.2	9.6	3,273,124	9.2	108.4	292
54 Stockton	58	23	57	1,517	76	5.6	6.2	14.3	0.5	2,184	0.5	19.4	7.5	6.7	<0.1	-	-	2.1	2.8	0.7	214,289	0.6	133.9	0
18 Sacramento	24	3	24	1,516	182	9.2	17.3	22.1	0.0	3,267	0.8	21.2	6.3	21.3	-	0.1	-	1.9	1.3	0.4	204,290	0.6	117.4	0
14 Eureka	31	0	31	913	381	42.6	3.2	3.5	0.0	433	0.1	11.6	12.6	6.4	-	1.7	-	1.7	0.6	0.2	98,814	0.3	103.3	0
Northern California Total	1,146	230	1,096	1,657	19	2.8	2.5	5.5	0.6	53,976	13.5	26.1	7.9	17.7	12.7	1.8	5.9	14.3	6.8	10.9	3,790,517	10.7	109.9	292
Oregon																								
12 North Bend/Coos Bay	93	16	90	1,186	184	43.5	1.1	1.9	0.7	1,309	0.3	10.0	8.9	0.9	<0.1	8.6	-	0.4	4.0	1.0	364,424	1.0	58.2	2,183
53 Newport	8	1	8	603	423	76.6	21.3	0.5	1.9	27	0.0	0.0	0.0	4.3	-	0.2	-	-	-	<0.1	0	0.0	-	0
50 Astoria	49	0	49	662	478	86.3	0.9	0.7	3.0	72	0.0	0.0	0.0	0.0	-	1.9	-	-	-	<0.1	0	0.0	0.0	475
8 Portland	464	57	450	1,851	9	2.6	12.0	2.5	0.5	23,692	5.9	14.4	7.5	5.3	2.2	3.4	18.0	7.0	23.7	8.2	2,989,317	8.4	104.1	5,903
4 Vancouver, WA	147	41	144	1,722	12	11.8	12.6	6.6	1.4	6,657	1.7	13.8	6.5	11.2	<0.1	0.2	2.8	4.0	8.8	2.3	923,937	2.6	108.2	0
21 Longview, WA	190	22	188	1,887	18	15.9	5.0	4.7	1.2	8,893	2.2	9.2	8.3	5.0	<0.1	30.0	-	5.8	12.4	3.2	1,323,112	3.7	84.2	13,546
Oregon Total	951	137	929	1,700	56	11.7	10.1	3.6	0.8	40,649	10.2	13.0	7.5	6.1	2.2	44.2	20.8	17.2	49.0	14.7	5,600,790	15.8	94.5	22,107
Washington																								
24 Aberdeen	70	0	70	1,342	167	23.6	7.7	3.2	0.0	1,881	0.5	6.6	6.3	0.7	<0.1	13.1	-	0.6	-	0.2	52,640	0.1	109.7	11,373
27 Port Angeles	54	0	53	715	513	62.0	5.7	1.1	2.8	352	0.1	9.2	7.3	0.0	-	2.0	-	<0.1	0.5	0.1	73,133	0.2	280.3	7,454
51 Port Gamble	12	0	12	405	678	82.3	0.0	0.0	0.0	17	0.0	0.0	0.0	0.0	-	-	-	-	-	-	0	0.0	-	0
47 Olympia	28	5	28	951	245	29.2	31.0	9.1	0.0	339	0.1	3.1	10.9	8.0	<0.1	1.4	-	0.1	-	<0.1	6,820	0.0	42.0	0
23 Tacoma	487	100	484	1,744	<1	2.2	3.2	8.6	0.4	24,385	6.1	21.8	8.9	7.8	8.3	18.3	10.8	3.2	8.9	8.5	3,089,251	8.7	89.9	0
19 Seattle	579	129	574	1,835	<1	1.5	4.5	9.4	0.2	33,114	8.3	25.7	7.8	8.1	12.5	0.3	4.0	3.1	2.6	9.2	3,533,407	10.0	106.4	7,936
32 Everett	55	0	55	1,072	240	16.6	14.4	5.6	0.0	1,298	0.3	6.1	7.4	2.4	<0.1	6.6	-	0.1	0.7	0.2	64,489	0.2	81.3	0
25 Anacortes	13	0	13	881	270	29.0	24.6	1.0	0.0	171	0.0	6.4	6.7	5.2	<0.1	0.9	-	-	0.5	0.1	26,238	0.1	48.2	0
7 Bellingham	32	0	32	847	257	21.4	7.2	3.3	9.7	808	0.2	11.1	11.6	9.3	-	-	-	0.8	1.6	0.4	145,863	0.4	179.5	0
Washington Total	1,330	234	1,321	1,634	60	5.1	4.8	8.6	0.4	62,365	15.6	22.7	8.2	7.6	20.9	42.7	14.9	7.8	14.8	18.8	6,991,841	19.7	99.0	26,763
Total/Average	7,594	1,681	7,461	1,860	20	2.8	3.0	8.8	0.5	398,957	100.0	23.1	9.1	15.3	100.0	100.0	100.0	100.0	100.0	100.0	35,467,963	100.0	105.7	63,876
% Change from Update of 4/98	+7.8	+7.9	+8.1	-0.8	+11.1	-0.3	-1.1	-0.2	-0.2	+2.1	+0.7	0.0	-3.4		4.8%	-12.6%	0.4%	24.8%	-16.1%	-0.4%				-55.9%

Clerks												
29 San Diego	4	0	4	***	***	11.4	32.5	10.5	1.4			
46 Port Hueneme	12	0	12	2,409	-	2.4	27.5	8.9	0.0			
63 Los Angeles/Long Beach	941	1	927	2,666	<1	0.2	11.0	11.2	0.4			
14 Eureka	3	0	3	***	***	21.4	34.9	0.0	0.0			
34 SF Bay Area & Delta	283	11	279	2,334	2	2.6	9.9	2.0	0.4			
40 Portland	94	0	90	2,480	1	32.3	11.0	1.7	1.1			
23 Tacoma	71	0	71	2,498	-	1.6	35.9	0.8	0.4			
52 Seattle	172	0	172	2,517	-	12.8	12.1	3.2	1.5			
Total/Average	1,580	12	1,558	2,566	1	3.9	12.6	8.0	0.5			
Foremen/Walking Bosses												
29 San Diego	2	0	2	***	***	0.7	70.9	1.1	0.1			
46 Port Hueneme	5	-	5	2,306	3	0.0	40.5	0.2	0.0			
94 Los Angeles/Long Beach	356	-	350	3,478	<1	0.2	4.5	0.0	0.5			
91 Northern Calif. Area	76	-	75	2,544	35	0.6	13.3	0.0	1.0			
92 Portland	50	-	49	2,514	14	12.6	14.7	0.0	2.5			
98 Seattle	98	-	96	2,547	13	9.5	10.9	0.0	0.0			
Total/Average	587		577	3,108	8	2.4	8.2	0.0	0.6			



* Longshore and Clerk hours only. *** "Annual Hrs Pd" and "Wkly PGP" for groups of less than five individuals are not shown, but the data are included in category averages.