An assessment of wage and skill level among logging equipment operators in the USA

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Summary

After more than a decade of decline in the number of logging firms and employees in the USA, logging employment appears to have stabilized at more than 49,000. Currently logging trade publications and associations are focused on recruiting and retaining workers and firm owners to prepare for increased harvest levels. While working conditions are a concern, the primary focus is income levels that will attract and retain workers. Turnover is high with 20% of workers new to firms each year. In 2013, we conducted a survey of logging firm owners, supplemented with interviews of logging show attendees, to examine the expected skill level of logging employees and the wage rates related to those skill levels. For logging equipment operators (EO) only three firm attributes were related to differences in wage levels (firm employees, aerial system, and number of sorts). For experienced EO the wages started at US$14.60 hr^{-1}. For highly productive operators the average wage increased to $18.30 hr^{-1}. Unskilled trainee wages were $11.30 hr^{-1} with little increase for improved safety performance ($11.90 hr^{-1}). To examine competitiveness for labor we explored wage levels and working conditions for similar jobs in other industries using the O*NET occupational classification system.
Keywords: logging equipment operator, wage, occupational choice, forest worker, logger

Introduction

Rural migration was identified as the major issue in recruiting logging workers in the 1960's and 70's in the USA (Irland 1973). Throughout the 1960's and early 70's advocates looked to training to both improve the existing workforce and increase the supply of new workers (Berger 1972). Most training efforts were short lived. The mechanization of logging and increased productivity lowered demand for workers even in the face of increasing harvests from the 1970's to the 1990's.

More recently growth in labor productivity has slowed and wage growth exceeded it in the 1990's (Parry 1999). By the end of the most recent recession logging employment was reduced to the lowest level in recent history. Constrained productivity growth combined with demand recovery might require substantial recruitment of new logging workers and entrepreneurs. Even without employment growth, employers have to replace the 20% of logging workers who are new or change firms each year (SUSB 2014).

Discussions and analyses of logging worker recruitment have addressed working conditions, job status, wages and benefits, and increasing worker supply through training programs (Cottell 1974; Egan and Taggart 2004; Goldstein et al. 2005; Ward 2013). A recent survey of logging employers indicated that a majority find recruiting a challenge and a combination of working conditions and pay contributed to the negative outlook on recruitment (Ward 2013). Surveys of logging contractors indicate the positive aspects of the logging work: outdoor work, independence, and work challenges. Opinions vary on desirability of logging pay, perhaps due to the alternatives available in rural areas. Negative aspects of logging work identified in surveys included: physical outdoor work, longer and less regular work schedules, low social status, exposure to hazards (Egan and Taggart 2004; Egan and Taggart 2009; Keefer et al. 2003; Leon and Benjamin 2012). Personal characteristics may play a large role in whether job aspects are negative or positive (e.g. outdoor work).

Recruitment in logging, especially among firm owners, relies on local family networks (Allred 2009; Cottell 1974; Egan and Taggart 2009). Discouragement toward logging work within logging families could be especially damaging to recruitment. Job choice among those outside the family network still relies on knowing about an occupation by an early age (Foskett and Hemsley-Brown 1999). Choice among known occupations is often related to the net present value of earnings (Boskin 1974) where training costs are included. Job switching between industries is discouraged since earnings typically increase for those with expanding job tenure due to significant investments in job specific knowledge and skills (Parent 2000). Economic models of occupations choice involving logging found job status and discouragement were important in selection of logging occupations in Maine (Goldstein et al. 2005).

Since logging jobs are primarily in rural areas opportunities for education or for alternative careers may appear limited. Among many the sense of place in a community or sense of identity with a profession keeps them from leaving even though they view the option negatively (Marshall 2002). The reduced supply of intergenerational workers and new labor demand might require more direct competition for workers who could be successful as logging employees due to work values and abilities. The main objective of this analysis was to compare work as a logging equipment operator to occupations likely to attract similar workers. The occupations identified might help to determine critical aspects of competitiveness in recruiting and retention.

Methods

In 2013 we conducted a survey that produced wage distribution for logging equipment operator, chainsaw operator and supervisor (Xu 2013). The survey was conducted over a period of 7 months and was directed toward logging firm owners and supervisors across the USA. Survey distribution utilized mixed methods (internet and mail). Interviews were added due to poor response to the online survey.

For occupational information we utilized O*NET (www.onetonline.org). O*NET is a database of occupational information developed for the U.S. Department of Labor. Data about the occupations were developed from surveys of businesses which employ occupations and workers in those occupations. We used data from Ability, Work Activities, Work Context, and Work Values to differentiate among occupations. Occupations are classified by the Standard Occupation Code (SOC) which includes a hierarchy of occupational classifications. The detailed SOC for logging equipment operator is 45-4022.00. Data and descriptions of broader classifications are 45-4000 for forest, conservation and logging workers and 45-4020 for logging workers.

In O*NET the match between an individual and occupations are made from the comparison of the results of a questionnaire or aptitude test to the O*NET occupation profile. The quantitative comparison between the individual and the occupation for each of the attributes may be based on the sum of the squared distances for all the attributes compared or the correlation among the corresponding attributes between the individual and the occupation (McCloy et al. 1999). Typically strong matches have a correlation coefficient greater than 0.475. For the comparison we treated the O*NET scores for the logging equipment operator (45-4022.00) as the individual and used Ability as the primary screening criteria.

We developed wage and total employment attributes for each occupation using Bureau of Labor Statistics (BLS) data for 2012 (BLS 2013b). For occupations without the most detailed occupational wage data (e.g. 11-1111.01) we applied wage data from the broader (e.g. 11-1111.00) occupation. Employment projections were downloaded from BLS data (BLS 2013a) and we applied data to missing occupations in the same way as wage data. For occupations where no projections were available we assumed occupation growth was zero.

To narrow the selection of occupations we excluded occupations at two wage levels ($10.00 hr^{-1} and $14.75 hr^{-1}). The first is the lowest wage available in the survey and $14.75

is 90% of logging equipment operator median wage. Additionally we excluded occupations with total employment less than 30,000 people, negative employment outlook, job zones 3, 4, and 5 (post-secondary education/training required), and correlations with ability of less than 0.475. We compared these occupations to logging equipment operator by isolating specific negative and positive attributes of logging occupations from the literature (Table 1) and identified the corresponding O*NET occupational measures in Work Activities, Work Context, and Work Values. For measures within +/- 10% of the measure for logging equipment operator, we assumed they were the same (value = 0). If the measure indicated the occupation was more desirable than logging equipment operator the value was 1. Finally if the measure indicated the occupation was less desirable than logging equipment operator the value was -1.

Results

We had 164 total respondents and about 50% were from the logging show interviews. Considering the surveys which were sent directly to individuals (email or mail) the response rate was low (about 2%). We have limited expectation that the respondents were a representative sample of logging firms. Statistics of the firm demographics indicated that the respondents represent firms that were larger than the average firms in the USA. Respondents had slightly high education levels (38% with at least some college) than are indicated elsewhere, but were of similar average age (47 years old).

We asked survey respondents to estimate by range the minimum experience needed and the relative performance level expected of experienced employees (100 was expert operator). For all respondents the expected productivity level averaged 70. Expectations for productivity generally increased with expected experience (Figure 1). Expectations for safety performance were high regardless of experience. The median and mode response for minimum experience were both in the 12 to 23 month range.

The four skill levels that were included in the survey were: LL: Low in Productivity and Safety; LM: Low in Productivity and Medium in Safety; MH: Medium in Productivity and High in Safety; and HH: High in Productivity and High in Safety. LL and LM represented skill levels of newly recruited workers. HH levels represented an expert operator and MH represented the minimum performance level for an experienced worker corresponding to levels in Figure 1. The OES average wage was between MH and HH skill levels (Table 2). The first quartile wage from OES data was between the LM and MH levels and the 3rd quartile was higher than the HH level. Wages in western states were about $4 hr^{-1} higher than national average wages. From OES the difference was between $20.83 hr^{-1} versus $16.69 hr^{-1} from OES) in our data the difference was also present ($22.13 hr^{-1} versus $18.34 hr^{-1} for HH level).

For ability ratings the level scales are from zero to seven and have specific activity based anchors with seven as the highest level of performance. Importance scales are from one to five based on need for that ability with five as the greatest need. A group of physical abilities were rated high in importance and level for logging equipment operators, however the levels are not extremely high (4 of 7). An importance weight of three or greater was present on 19 of the abilities with most of those being physical or sensory. The comparison to other occupations was based on the multiplication of level and importance.

When we set the median wage in the screen to $10 hr^{-1}, we identified 58 similar occupations with total employment of 10 million. Nearly all of those occupations were in Job Zone 2. Most of the occupations and employment were in 3 general areas with average wages from $17 hr^{-1} to $19 hr^{-1}. Twelve were in construction occupations, 28 in production occupations (manufacturing), and 10 in transportation occupations.

After we changed the screening criteria to $14.75 hr^{-1} only 37 occupations remained with total employment of 4.7 million (Table 3). Only one of these jobs was in job zone 1. Occupations with about 3.5 million jobs had wages greater than the logging equipment operators at the HH level, another one million jobs were between the logging equipment operator median and the HH level. All of the remaining jobs have median wages higher than the MH level logging equipment operator.

Figure 1. Expected safety and productivity performance levels (average) given the experience needed to achieve those performance levels for logging equipment operators.

Table 1. Logging work attributes from logging contractor and logging employee surveys and corresponding O*NET content or wage data. Attributes were designated as a positive (+) or negative (-) attribute of logging work according to the survey results.

O*NET Content reference		Ward 2013	Keefer et al. 2003	Egan & Taggart 2004 & 2009	Leon & Benjamin 2012
			References		
Work context	Duration of typical work week	(-)			
	Work schedule	(-)			
	Work steadiness	(-) and (+)			
	Outdoors exposed to weather	(-) and (+)	(+)	(+)	
	Exposed to hazardous conditions			(-)	
Work activities	Physical work	(-)		(-)	
Work value	Independence		(+)	(+)	(+)
	Achievement	(+)	(+)	(+)	(+)
	Recognition	(-)		(-) and (+)	(-)
	Working conditions	(-) and (+)		(-)	(+)

Table 2. Statistical summary for logging equipment operator wages (US$ hr^{-1}) at given performance levels. 2013 Occupation Employment Survey (OES) estimates for 45-4022.00 were downloaded from http://www.bls.gov/oes/.

Region	Productivity /Safety levels	Average	1st Q	Median	3rd Q	Standard Deviation
All	LL	11.26	10.00	10.00	11.73	2.39
	LM	11.94	10.00	11.25	12.50	2.51
	MH	14.55	12.00	15.00	15.60	3.16
	HH	18.34	15.00	18.00	20.08	4.41
National	OES	16.69	12.95	16.39	20.03	

We computed relative values for the attributes given in Table 1 for these 37 occupations (Table 4). The values recorded indicated whether the occupation was the same as logging equipment operator (+/- 10%), more desirable (1) or less desirable (-1) depending on whether the survey respondents indicated the characteristic was a positive or negative aspect of logging work. We included outdoor work as positive and negative since survey

responses were in both directions. With outdoor work as negative 27 of the occupations with 3.7 million in employment were the same as or more desirable than logging equipment operator. Only 10 occupations with about 1 million in employment were less desirable than logging. If outdoor work is positive only 5 occupations are less desirable with total employment less than 0.5 million.

Table 3. Standard occupational code (SOC) and occupation data for occupations selected following the application of screening criteria. Criteria were: Median wage > US$ 14.75 hr^{-1}, Ability Correlation > 0.475, Employment > 30000, and Job Zones 1 and 2.

SOC	Occupation name	Job Zone	Employ-ment (1000)	Median Wage	Ability correl-ation
51-8093.00	Petroleum Pump System/Refinery Operators	2	41	29.77	0.52
43-5052.00	Postal Service Mail Carriers	2	307	27.16	0.48
53-4031.00	Railroad Conductors and Yardmasters	2	43	26.95	0.54
51-8091.00	Chemical Plant and System Operators	2	39	26.31	0.54
53-4011.00	Locomotive Engineers	2	37	25.63	0.84
51-9011.00	Chemical Equipment Operators and Tenders	2	60	22.95	0.59
51-2011.00	Aircraft Structure, Surfaces, Rigging, and Systems	2	43	22.76	0.59
47-2221.00	Structural Iron and Steel Workers	2	57	22.36	0.64
33-2011.02	Forest Firefighters	2	303	21.92	0.62
47-2211.00	Sheet Metal Workers	2	134	21.1	0.54
47-5013.00	Service Unit Operators, Oil, Gas, and Mining	2	59	20.57	0.74
47-2073.00	Operating Engr. & Other Construction Equipment	2	341	20.45	0.89
49-9043.00	Maintenance Workers, Machinery	2	90	20	0.58
53-7032.00	Excavating & Loading Machine & Dragline Oper.	2	45	18.7	0.92
53-3032.00	Heavy and Tractor-Trailer Truck Drivers	2	158	18.61	0.88
51-9012.00	Separating, Filtering, Clarifying, Precipitating, an	2	43	18.43	0.57
47-4041.00	Hazardous Materials Removal Workers	2	40	18.23	0.65
47-2071.00	Paving, Surfacing, & Tamping Eqpmt. Operators	2	56	18.16	0.81
51-2031.00	Engine and Other Machine Assemblers	2	40	17.93	0.57
51-4023.00	Rolling Machine Setters, Operators, & Tenders	2	33	17.8	0.78
49-9099.01	Geothermal Technicians	2	136	17.66	0.57
53-3021.00	Bus Drivers, Transit and Intercity	2	158	17.64	0.82
43-5041.00	Meter Readers, Utilities	2	38	17.51	0.57
47-2151.00	Pipelayers	2	41	17.44	0.60
47-2051.00	Cement Masons and Concrete Finishers	2	142	17.37	0.48
47-4051.00	Highway Maintenance Workers	2	139	17.25	0.80
51-4034.00	Lathe and Turning Machine Tool Setters, Oper.	2	42	17.18	0.64
51-9196.00	Paper Goods Machine Setters, Oper., & Tenders	2	95	16.73	0.59
47-5071.00	Roustabouts, Oil and Gas	1	68	16.62	0.64
51-4122.00	Welding, Soldering, and Brazing Machine Setters	2	51	16.54	0.56
51-4081.00	Multiple Machine Tool Setters, Oper. & Tender	2	93	16.5	0.64
45-4022.00	**Logging Equipment Operators**	**1**	**24**	**16.39**	**1**
37-3013.00	Tree Trimmers and Pruners	2	41	15.67	0.69
51-9021.00	Crushing, Grinding, & Polishing Machine Setters	2	31	15.52	0.76
51-4021.00	Extruding & Drawing Machine Setters, Oper.	2	73	15.51	0.75
51-4033.00	Grinding, Lapping, Polishing, & Buffing Machine	2	71	15.49	0.82
51-9032.00	Cutting and Slicing Machine Setters, Operators,	2	59	15.29	0.65
51-9041.00	Extruding, Forming, Pressing, & Compacting	2	70	15.27	0.69

Discussion

Among occupations which were characterized as having abilities to similar to logging equipment operators, logging equipment operators have among the lowest wages and most other occupations were more desirable in key areas. Even highly skilled operators had wages

lower than most of the employment in the occupations identified. Operators with adequate performance levels had wage levels lower than nearly all the identified occupations. Wage data should already reflect wage additions based on production incentives (Haley 2003; Olsen 1988; Schuh and Kellogg 1988). The wages may not reflect contribution of expanded hours available, but only a few occupations had fewer work hours.

Table 4. Comparison with O*NET content. More desirable is 1, -1 is less desirable, 0 is within 10% of logging equipment operator (LEO). Sums are the arithmetic sum of the 9 values. O*NET abbreviations are: Work Values: Achievement (A), Independence (I), Recognition (R). Work Context: Working condition (W), Physical work (P), Duration of Weekly work (D), Outdoor work exposed (OE), Outdoor work covered (OC), and Exposed to hazards (E).

| SOC | Median Wage | O*NET criteria | | | | | | | | | Sum Outdoor Negative | Sum Outdoor Positive |
		A	I	R	W	P	D	OE	OC	E		
51-8093.00	29.77	1	1	1	1	1	0	0	-1	-1	3	7
43-5052.00	27.16	0	-1	1	1	-1	0	0	-1	1	0	2
53-4031.00	26.95	1	1	1	1	-1	0	0	1	-1	3	5
51-8091.00	26.31	1	1	1	1	-1	0	1	-1	-1	2	5
53-4011.00	25.63	1	0	1	1	1	0	0	-1	-1	2	6
51-9011.00	22.95	1	1	1	1	-1	0	1	-1	-1	2	5
51-2011.00	22.76	1	0	1	1	0	0	1	1	-1	4	5
47-2221.00	22.36	1	-1	1	0	-1	0	0	-1	-1	-2	2
33-2011.02	21.92	1	1	1	1	-1	0	0	-1	-1	1	5
47-2211.00	21.10	1	0	1	0	-1	1	1	-1	-1	1	4
47-5013.00	20.57	1	0	1	0	-1	0	0	-1	-1	-1	3
47-2073.00	20.45	1	-1	1	1	0	0	0	-1	-1	0	4
49-9043.00	20.00	1	1	1	1	-1	0	1	-1	-1	2	5
53-7032.00	18.70	0	0	0	0	-1	0	1	0	-1	-1	1
53-3032.00	18.61	1	1	1	1	-1	0	0	0	0	3	5
51-9012.00	18.43	-1	0	1	1	-1	0	1	-1	-1	-1	2
47-4041.00	18.23	1	0	1	0	-1	0	1	-1	-1	0	3
47-2071.00	18.16	0	0	0	0	-1	0	0	1	-1	-1	1
LEO – HH	**18.00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
51-2031.00	17.93	1	0	1	1	-1	0	1	1	-1	3	4
51-4023.00	17.80	-1	-1	1	0	-1	0	1	1	-1	-1	0
49-9099.01	17.66	1	-1	1	1	-1	0	0	-1	-1	-1	3
53-3021.00	17.64	1	1	0	0	-1	1	1	0	0	3	4
43-5041.00	17.51	1	0	1	1	-1	1	0	1	-1	3	5
47-2151.00	17.44	0	0	1	0	-1	0	0	1	-1	0	2
47-2051.00	17.37	0	0	1	0	-1	0	0	-1	-1	-2	2
47-4051.00	17.25	-1	-1	0	0	-1	1	0	-1	-1	-4	0
51-4034.00	17.18	1	-1	0	0	-1	0	1	1	-1	0	1
51-9196.00	16.73	-1	-1	0	-1	0	1	1	1	-1	-1	0
47-5071.00	16.62	-1	-1	-1	0	-1	-1	0	-1	-1	-7	-3
51-4122.00	16.54	0	0	0	0	1	0	1	1	-1	2	3
51-4081.00	16.50	-1	-1	0	0	1	1	1	1	-1	1	2
45-4022.00	**16.00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
37-3013.00	15.67	1	0	1	0	-1	0	0	-1	-1	-1	3
51-9021.00	15.52	1	-1	1	0	-1	0	1	0	-1	0	2
51-4021.00	15.51	-1	-1	0	-1	-1	1	1	1	-1	-2	-1
51-4033.00	15.49	-1	-1	-1	-1	0	0	1	1	-1	-3	-2
51-9032.00	15.29	0	0	1	0	-1	0	1	1	-1	1	2
51-9041.00	15.27	0	0	0	-1	-1	1	1	1	-1	0	1
LEO –MH	**15.00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Our understanding of the attributes that affect occupational choice of logging workers in the US is limited with some information Northeastern USA (Egan and Taggart 2004; Goldstein et al. 2005) and Canada (Cottell 1974). Enhancing retention and recruiting of logging workers should begin with a better understanding of the current workforce. We have relied heavily on firm owners for information about logging workers since they have similar experiences. It is worth considering that workers that do not become firm owners may have different expectations from and attachment to logging work than their employers.

We expect that the most important driver of occupational choice is economic (Carroll et al. 2000; Egan and Taggart 2004) although lifetime earnings did not affect choice among Maine workers (Goldstein et al. 2005). Evaluations that studied worker displacement following loss of company logging jobs showed that most chose either to remain in logging since it was the most profitable option or chose another option that avoided relocation (Carroll et al. 2000). Individuals had strong sense of community attachment and a personal and familial identification to logging (Egan and Taggart 2004).

Since the people choosing logging employment are not perfectly matched to logging, the actual universe of opportunities is larger than shown in Table 3. However, opportunities may be limited by geographic availability. Since relevant choices could be at the county level they are too complex to analyze here. Enhancing success in recruiting and retention could involve addressing wage, working conditions, or skill level. We present three strategies that might be used individually or in combination.

Since wage is tied to productivity, wage competition with other occupations may only be available to logging systems with high labor productivity. This may be an option for firms that can produce and capture value from any source (productivity, landowner service, merchandizing, etc.). This supply chain must support the productivity and value creation of contractors not only from the perspective of contractor income but wage competitiveness.

Increasing the desirability of logging by supporting and communicating the attractive work values may help recruiting. We would stress that our limited understanding of the target population makes it difficult to design an effective message. A few surveys identify attributes from the employers' perspective and even fewer from the workers'. At the most basic level we need to examine the needs and characteristics of desirable operators and determine how to communicate messages that address those needs.

The final strategy is to continue or accelerate the process of changing the job to "fit" a wider pool of applicants. One alternative is to make the job simpler, physically easier, and safer and hence more representative of Job Zone 1. Additional training to increase the fit of the recruit to the job could be supported by those firms whose logging systems support the higher wages. The cost of training (both direct and opportunity costs) must be support by the potential for higher lifetime earnings. Even with some training, new trainees may not have enough specialized knowledge or skill that would limit job switching for more desirable and higher wage jobs. We believe that for training to be effective it has result in a broad range of logging skills, autonomy, and value creation. Essentially the training should produce the knowledge and skills to embark on a career path in logging and an eventual role as a supervisor or entrepreneur. The training objectives are to clearly identify larger lifetime earnings and establish a level of personal and financial investment that discourages job switching.

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