Extended Working Shifts: Are They Applicable to the Southeastern United States?*

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Abstract
Logging operations in Scandinavia, Canada and the Lake States of the United States have used non-traditional (extended) working hours to increase their production for many years. However, extended shifts are uncommon in the southeastern United States. A major limitation in implementing extended working hours in the southeastern states is that logging business owners do not have a full understanding of the costs and benefits associated with extending shift number or length. This two-year project will test two questions. The first is whether extended shifts increase production and control unit costs. Safety, night productivity, employee turnover, and tax implications of machine depreciation are just some of the tangible and intangible costs and benefits that will be evaluated. The second question is whether an acceptable number of harvest cuts are suitable for extended work hours. These harvest parcel (tract) variables need to be identified and their impacts quantified. The objectives of this study are to: (1) characterize the extended shift work hour methods used in the Lake States, (2) identify factors for tract selection, (3) identify loss control and safety issues, (4) quantify the differences in machine costs between shingle shift and extended shift, and (5) develop a business decision-making tool to aid logging business owners in quantifying the costs and benefits of extended work shifts. The paper presents some initial findings from interviews with logging contractors who have successfully, and not so successfully, implemented extended working hours.

Keywords: extended working hours, logging methods, work scheduling

1. INTRODUCTION

Logging operations in Canada and the Lake States of the United States have used extended working hours for many years in order to maintain production, often due to ground conditions. Extended shifts are so common in Canada that at forestry training centers in New Brunswick and Quebec, students are required to operate equipment for 24 hours/day, 7 days/week for real life experience (Turtle, 1997). However, extended work schedules are uncommon in the southeastern United States (Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina). Logging business owners in the southeastern states are wary of extended working hours because there have been limited incentives and pressures for experimenting. From discussions with loggers and consultants, we find that the most common methods for increasing logging production in the southeastern states is to add processing mechanization, increase machine size, balance the system, or add a second crew with a complete second set of logging equipment.

* *The 29th Council on Forest Engineering Conference. Coeur d'Alene, Idaho, July 30-August 2, 2006. W. Chung and H.S. Han, editors. pp. 513-522.*

There isn't a specific definition of extended working hours because there are so many options available. Extended hours can be two overlapping day shifts where overlap hours are used for maintenance; three shifts per day; 12-hour shifts; more days per week; or other options for extending working hours. In addition, some businesses may employ a rotating shift schedule. The production goal set by logging business owners will be a factor in determining the number of extended scheduled working hours needed. This project will explore the logging costs associated with a variety of production levels.

Articles about extended work hours have become frequent in trade magazines within the past few years. While some of these local and regional publications have profiled experiences of logging businesses using extended work hours, none have provided adequate business accounting detail for decision making and analysis of extended work hours in the southeastern states. Many of these articles portray Canadian businesses. It is difficult to compare these businesses to the southeastern states because of the differences in income expectations, labor demand, wood storage and transportation, tax laws, accounting procedures, governmental regulations, and land ownership patterns.

Two questions need to be addressed in order for business owners to make sound decisions. The first is to determine whether logging costs can actually be decreased by extending working hours in the southeastern states. Safety, night productivity, employee turnover, impact of delivery quotas, crew supervision, and tax implications of machine depreciation are just some of the tangible and intangible costs that need to be evaluated.

The second question to be analyzed is the selection criteria used to determine tract (parcel of land) suitability for extended working hours. If a tract has sensitive areas, such as streamside protection zones, it may be difficult to avoid them in the dark. In addition, light conditions may change the operator's depth perception in rough terrain and shadows may make rocks or gullies more difficult to see. Equipment noise, log truck traffic, and other logging-related variables can become factors in tract selection when working near the wildland urban interface.

The objectives for this study are to:

1. Characterize the extended work shift methods used in the Lake States,
2. Identify factors to consider for extended work shift tract selection,
3. Identify safety issues related to extended work shifts,
4. Quantify the differences in machine costs between traditional and extended work hours, and
5. Develop a business decision-making tool to aid logging business owners in determining whether or not to attempt implementing extended work shifts.

The goals of this research are to provide the logging community a thorough analysis on the benefits and costs of extended work hours and to develop a decision-making tool to aid in the determination of implementing extended shifts.

2. RATIONALE AND JUSTIFICATION

2.1 Can extended working hours actually decrease per unit logging costs?

According to a recent report (Stuart et al, 2005), logging costs have increased 35% from 1995 to 2004. Prices paid for logging services have decreased by 10%. Logging businesses are looking for ways to reduce their costs or increase the value of their services or products to stay in

business. Working extended hours is an opportunity that loggers may use in an attempt to reduce unit logging costs and make a firm a more valuable producer to a procurement organization.

The major cost components for a logging business are: administrative overhead, contract services, insurance and taxes, labor, consumables (including fuel), and equipment. On average, equipment may account for just 15% of these costs (Stuart et al, 2005), but it is one of the few categories that can be controlled through business decisions. The current trend is that small and mid-size firms are extending equipment life to minimize risk from debt service. One way to increase debt retirement may be to work one set of logging equipment for extended hours.

Machine Costs

New logging equipment is an expensive capital investment. The manufacturers suggested retail price of a new 215 hp, rubber-tired grapple skidder ranges from $185,000 to over $200,000 (USD) depending on the options included. Most logging businesses include several additional pieces of expensive heavy equipment, such as feller-bunchers and loaders.

Because of the high level of capital investments required, businesses need to keep these machines productive. The number of scheduled machine hours (SMH) for a typical logging operation with one feller-buncher, two skidders and one loader is about 2000 hours per year. This generic number allows for fifty, 40-hour work weeks and two weeks for vacations, holidays, or other non-productive periods. It is expected that extended work schedules would increase machine hours which is one of the basic variables used in calculating machine rates. It is expected that increased scheduled machine hours will increase the total production for a set of equipment over a weekly or yearly basis, while reducing the period of debt repayment and finance costs for a given level of capital.

A machine rate method is typically used to determine the cost of producing a unit of wood (Brinker et al, 1989). This method provides an average yearly cost over the life of the machine and only accounts for straight line depreciation. Table 1 displays a machine rate analysis that offers a simple comparison of a variety of extended work hours. The basis for the production and cost comparison is a 215 hp rubber-tired grapple skidder. This is just one piece of equipment that may be found on a logging operation. To perform a full cost analysis, all pieces of equipment would need to be included. But, since different logging operations use different mixes of equipment, a single skidder is used to display some of the cost differences that can be expected from different schedules.

For an arbitrarily chosen production rate of 26.4 green tons/SMH, the traditional schedule (2000 SMH/year) costs $2.65/ton of wood produced. In the first alternative (Alt. 1), the annual number of scheduled machine hours is increased from 2,000 to 3,000. It is assumed that the machine will be traded in at the same number of machine hours (10,000), which reduces the machine life to 3.33 years. Alternative 1 reduces the cost of producing a single ton of wood by $0.14. In the second alternative (Alt. 2), the scheduled machine hours increase to 4,000 hours/year, and the life of the machine is reduced to 2.5 years. This alternative results in a $0.21/ton cost reduction as compared with the traditional schedule. Alternative 3 is displayed to show the estimated machine rate impacts of adding a second set of equipment and crew. As expected, the cost of producing a ton of wood under this alternative is the same as that calculated for the traditional schedule ($2.65/ton).

Table 1. Machine Cost Comparisons

Skidder	Traditional Schedule	Alternative 1 3000 SMH/Yr	Alternative 2 4000 SMH/Yr	Alternative 3 Traditional Schedule with Two Machines
Purchase Price ($)	207400	207400	207400	
Life (yrs)	**5**	**3.33**	**2.5**	Values are
Horsepower	215	215	215	twice the
Salvage ($)	41480	41480	41480	traditional
Depreciation ($/yr)	31664	47544	63328	schedule
Interest ($/yr)	14103	14935	15762	
Insurance ($/yr)	10370	10370	10370	
Fuel & Lube ($/PMH)	15.46	15.46	15.46	
Repair & Maintenance ($/PMH)	23.75	23.75	23.75	
Tires ($/PMH)	0.76	0.76	0.76	
Labor & Benefits ($/SMH)	18.00	18.00	18.00	
Utilization Rate (%)	60	60	60	
SMH/Year/Machine	**2000**	**3000**	**4000**	
Production Rate (tons/PMH[a])	44.0	44.0	44.0	
Production Rate (tons/SMH)	26.4	26.4	26.4	
Number of machines	1	1	1	2
Fixed Costs ($/SMH)	28.07	24.28	22.37	56.14
Operating Costs ($/SMH)	41.98	41.99	41.98	83.96
Total Costs ($/SMH)	70.05	66.28	64.34	140.10
Cost per ton ($/ton)	**2.65**	**2.51**	**2.44**	**2.65**

[a] PMH is the portion of the scheduled machine hours that the machine actually works. PMH equals SMH reduced by the utilization rate.

The potential costs and benefits need to be explored to determine the differences that may be expected under extended work hours. Although the machine rate calculations provide a quick method of comparing costs, they do not reflect real life business accounting methodology. Some of the questions to be explored are:

1. Are machines and workers as productive in the extended hours as compared to the traditional work hours? Does the utilization rate change?

2. Which method of calculating depreciation is most advantageous to use when working extended hours?

3. Are machines replaced at the same number of total machine hours as under the traditional work schedules?

4. Are repair and maintenance costs the same with extended work hours as compared to traditional work schedules?

Many of the normal machine costing procedures may be appropriate to apply to the machines used on the extended work schedule. The regular scheduled maintenance that is normally performed after a certain number of machine hours will not change, but those maintenance costs will be borne in a shorter time frame under the extended work hours approach. For example, the oil change schedule for Alternative 2, double the scheduled machine hours as compared to the traditional working schedule, would require oil changes be performed twice as frequently as those for the machine used in the traditional working schedule.

Some of the common assumptions used when determining machine costs will not apply to machines that have been operated for extended hours. While maintenance costs will be incurred in a condensed time frame, the repair rates may change. If a machine is working after dark under poor lighting conditions, will operators drive over terrain that they would have avoided during the day? Will the additional bumps and scrapes due to poor lighting increase the repair costs?

On the other hand, because the machines are newer and replaced on an accelerated timeframe, will the repair and maintenance costs decrease? Some contractors working on a traditional work schedule may delay scheduled maintenance until the crew moves to another tract, the weekend, or a rainy day. Maintenance delays of this type could add to the wear and tear on the equipment. When two crews rely on the equipment, the maintenance schedule may be adhered to more strictly. Will two or more operators provide better daily maintenance than the traditional one person per machine per day? These questions need to be addressed to provide an adequate comparison of the costs associated with the alternatives.

Other Costs

Inventory

A larger inventory of common repair parts (hoses, oil and filters) may be needed because supply vendors will probably not be open during the extended work hours. When machines are used for extended hours, repairs will need to be performed quickly because the down time could potentially affect more than one crew. In some areas, vendors have been very helpful by opening day or night for emergencies. One crew that was interviewed was found to have a supply trailer filled with spare parts supplied by the vendor. The vendor inventories the trailer contents and invoices the logging business for products removed. This is advantageous in reducing equipment downtime, but many companies may not be able to have this in-woods inventory. It is unknown whether there is a price premium paid to have the supply trailer on site.

Employee Turnover

We suspect that employee turnover may be greater when employees are required to work extended shifts. If the operation requires employees to change shifts, work longer hours, or work a permanent evening or night shift, we expect that employee turnover may be higher than on crews working traditional logging work schedules. Many people do not want to work evening or night hours. Social affairs and other domestic activities are often oriented to a traditional work schedule. One logging company that worked extended hours for over a year reported that they had trouble getting people to work on Friday nights because of high school football. On the

other hand, another crew that has operated under an extended working hour schedule for two years said that they have only lost one person due to the work hours. In fact, the flexibility to switch between shifts has proven to be advantageous to two separate logging operations.

Many forest workers do not receive any formal training for their responsibilities on a logging crew. On-the-job training is commonly provided by the employer or crew boss. It can be difficult to assign a cost for this training. If extended work hours increase the rate of employee turnover, additional costs for training will be incurred. Our current sampling of contractors is too small to make a determination on the impact of work shifts on the costs for employee training.

Wood Quotas

Mills often use delivery quotas to control their inventories. Are the extended shift operations impacted more than those using traditional work hours? Are extended shift operations issued quotas that are in line with their normal weekly deliveries? If not, what are the crew owners doing in response? Moving to tracts containing products that are not on quota is typically the first response to quotas, but not all tracts are suitable for extended work hours. Alternatively, do crew owners lessen the impact of quotas by laying off employees or alternating work schedules?

Lighting

There will be some initial costs to starting extended work hours if they involve working at night. Task lighting, such as additional lights mounted on equipment, pole lights in areas of concentrated activity, and flashing log load lights are just a few of the costs that may be incurred. Lighting requirements for highway work zones have been documented by the National Institute for Occupational Safety and Health (NIOSH) for road work zones (Pratt et al., 2001), but none are available for forest operations in the United States.

System Optimization

In addition to actual work schedule changes, businesses also differ on how work is implemented during extended work hours. A typical clearcut harvest operation may include one feller-buncher, two skidders, and one loader. Some operations could run this same set of equipment for additional hours each week to increase production and reduce overall costs (Alternatives 1 or 2). Another option is to add a second cutter to the daytime operations and concentrate on skidding (dragging cut wood to a centralized location), merchandizing (cutting the wood to mill specifications), sorting (separating different products into piles), and loading trailers during the night operations (Mims, 2005). This option helps to avoid problems associated with tree selection in thinnings after sunset. Another crew only processes wood at roadside and loads it onto trailers at night. Using a processing head allows the operator to safely buck the logs at night while obtaining the greatest value for each log. Most businesses that use non-mechanized operations, such as chainsaw felling, usually limit these activities to daylight hours due to worker safety concerns.

Some businesses work a smaller crew after dark because of equipment limitations. Cable skidder operations do not operate after dark, since the operator has to get out of the cab to hook up logs. These night crews may focus on merchandizing, sorting, loading and hauling at night. Some cable skidder operations have added a grapple skidder to their logging equipment fleet for

shifts after sunset. With a grapple skidder, operators do not have to exit the safety of the machine's cab to obtain a load of wood to drag (skid) to the landing.

Crew Organization

A business may need additional crew supervisors for the extended hours of work. Finding someone who can use good judgment to make decisions without having to call and wake the owner can be a difficult task. Since many logging businesses are small, owners may be reluctant to have the level of open communication needed to empower their crew leaders.

Logging contractors can run a variety of shift and work hours to increase production. Extended hours could be anything from working longer hours each week day with weekends off, to a 24 hours/day and 7 days/week schedule. One Canadian operation tried a variety of shifts, but finally settled on one where they work four nights and five days with the night crew ending on Thursday night with a long break before starting the day shift on Monday mornings (Fullerton, 2003). Another Canadian operation works four 10-hour days Monday through Thursday, 8 hours on Sunday evening, and 8 hours Friday morning. The crew goes home on Friday afternoon and returns to the logging camp on Sunday (Lammers, 2003). In Mississippi, a clear-cut logging operation has two shifts, a day and an evening shift. The evening shift starts at 3:30 p.m. and ends at 11 p.m. (Rottgering, 2004). It may take time and patience for a business to find the right work schedule to be successful at increasing their production.

2.2 What are the safety issues related to extended working hours?

It is expected that workers would be more susceptible to twisted ankles and related safety problems when working in uneven terrain and downed timber after dark, even with additional lighting. For this reason, many operations choose to use only mechanized equipment after dusk. Workers can operate most mechanized equipment from the safety of the machine's cab, which reduces the risk of slips, trips and falls. It is unknown if working extended shifts will change workman's compensation rates. Insurance rates can be increased for logging companies while they are working in timber salvage operations, which have an increased worker safety risk, but many insurance companies assume that salvage logging includes chainsaw work. It is unknown if the insurance rates in the southeast will change with extended work hours.

Initial contacts with insurance companies indicate that workman's compensation insurance rates are not affected by working after dark. Insurance retailers don't have any guidance regarding rate modifications due to extended work hours. Differences will only be expressed as loss history accumulates. Two companies that were contacted are not aware if any of their customers are operating after dark. One company reported only allowing skidding and loading after dusk, with no rate modification.

One company reported that they do not write workman's compensation insurance policies for hauling after dusk. Their records indicate that many accidents involving log trucks occur at dawn and dusk. Most of these accidents are side impacts with the log trailer because of poor lighting on the trailer, even when the trailers meet state regulations. Reflective tape down the trailer's sides, rear lights, and strobe lights on the trailing logs are not enough to prevent these side impact crashes. For these reasons, they do not write workman's compensation policies for hauling logs in the dark.

This same company does not provide workman's compensation for felling after dark because they think it is inherently dangerous. Even though the company could not cite specific

data regarding increased felling accident rates after dusk, they felt that it was an unacceptable risk for the company's shareholders.

Lights on hard hats, reflective vests, and additional lights on equipment are some typical safety features added for employee safety when working in the dark. Additional lighting on log landings may also be needed because of the large amount of interaction that occurs in that area. Typically, skidder operators are busy pulling logs onto the landing, the loader operator is selecting wood to move into separate piles or loading wood onto a truck, and other trucks are backing in to be loaded. Landings are a dangerous working area during the day and the hazards are compounded after the sun goes down. If operations are not adjusted to reduce the activity on the landing after sunset, additional safety precautions on the landing are a necessity, not a luxury.

2.3 What are the variables that impact tract selection for extended hour operations?

Noise

The ownership pattern of timberlands plays a large part in the decision to select a tract for extended work hours. In Canada, large parcels of timberland are owned by the government. Logging equipment noise from working extended hours will not usually impact adjacent landowners. In the southeastern states, the timberlands are often near the wildland urban interface or near rural homes. Equipment noise is a concern in these areas during extended working hours.

Harvest Type

The type of harvest cut plays a major role in determining tract suitability for night logging. In a typical southeastern thinning operation, trees to be removed are selected by the equipment operator. Felling machine operators select forked and diseased trees for removal. In the dark, tree characteristics and basal area may be difficult to discern, and may result in quality control issues. In other thinning operations, trees to be removed may be marked with a slash mark of paint across one side of the tree bole. Again, these paint markings could be difficult to find in the dark. Thinning (marked and unmarked) operations could limit the felling portion of the operation to daylight hours to ensure quality tree selection and spacing. In clearcut operations, this is not as much of an issue.

Road Infrastructure

The road infrastructure also plays a role in working extended hours. In Canada, roads within large timberland parcels are owned by the government, so many of the haul miles are on roads with limited access. In the southeastern states, loaded log trucks haul a large percentage of their loads over county roads. Safety issues surrounding log transport at night become even more important when there are mixed types of traffic on a road. Many states have laws regulating the amount of overhang that is allowed from the rear of the trailer after dark. Others require a strobe light to be mounted on the longest log. If hauling after dark becomes more common, states may further restrict their transportation regulations.

Terrain

Not all sites are applicable to logging in the dark. When working in steep terrain, equipment operators may need to pick the safest travel route between trees, and this may be more difficult in the dark. Uneven terrain or small ravines may not be as visible in the shadows of the

night work lights. This provides additional incentives for some operations to limit felling to daylight hours.

Sensitive Areas

Extra precautions are often needed when working near sensitive areas, such as streams. Cutting timber in these areas usually requires directional felling. In the dark, the sensitive area may be beyond the lit working area, but within the tree's length, increasing the chance of having a tree top land in a protected area. The logging crew must take special protective measures to either log adjacent areas during the daylight hours, or adequately mark the sensitive areas for avoidance after sunset.

3. SUMMARY

Within the next two years, we hope to address the concerns outlined in this paper. Interviews with loggers will identify the variety of methods that they have used to extend working hours, what changes they have made to their operation to make the work schedule successful, and whether they plan to continue the extended work hours. In addition, loggers will be questioned about accident rates, crew productivity, tract selection and availability, and the impacts of delivery quotas. These interviews will be held in both the Lake States and in Southeastern States.

Financial aspects of an extended work hour operation may be different than those incurred under a traditional work schedule. Interviews will be held with tax attorneys and tax accountants to identify the tax advantages and disadvantages of working extended hours. The data collected from these interviews and those with the loggers will be compiled and a business decision-making tool will be developed.

Logging companies need to find ways to reduce their costs, while maintaining a desired standard of living. If loggers have to work more hours than they're currently working, many would rather find another business. But, when armed with more business cost information and adequate planning, business owners may be able to provide more reliable work schedules for employees, lower the cost to product a unit of wood, and raise profits.

4. ACKNOWLEDGEMENTS

Funding for this project was provided by the USDA Forest Service Southern Research Station, Auburn University School of Forestry and Wildlife Sciences, and the Wood Supply Research Institute.

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Council on Forest Engineering

PROCEEDINGS OF
THE 29TH COUNCIL ON FOREST ENGINEERING CONFERENCE

July 30 – August 2, 2006
Coeur d'Alene Resort
Coeur d'Alene, Idaho

Compiled and Edited by
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