

Financial Feasibility of a Log Sort Yard Handling Small-Diameter Logs: A Preliminary Study

Han-Sup Han, E.M. (Ted) Bilek, John (Rusty) Dramm, Dan Loeffler, and Dave Calkin

ABSTRACT

The value and use of the trees removed in fuel reduction thinning and restoration treatments could be enhanced if the wood were effectively evaluated and sorted for quality and highest value before delivery to the next manufacturing destination. This article summarizes a preliminary financial feasibility analysis of a log sort yard that would serve as a log market to buy and sell small-diameter logs in western Montana. We based our evaluations on equipment for a medium-sized log sort yard that would preprocess and sort 33 million board feet of small-diameter logs per year to seven different products. The delivered log input costs represent 78.1% of the total sales revenue, whereas the yard's operating costs account for 17.7% of the revenue. The log sort yard's operating cost would be \$3.74/piece or \$79.53/thousand board feet. Douglas-fir (*Pseudotsuga menziesii*) would make the biggest contribution to the yard's gross margin because this species both represents the largest volume (45% of the input log volume) into the yard and produces high-value products (house and veneer logs). Improved knowledge regarding wood market conditions and local log supplies is a prerequisite to understanding a log sort yard's financial feasibility.

Keywords: small wood utilization, value recovery, fuel reduction thinning, wood marketing

Anecdotal observations in the US West indicate that value recovery of sawlogs resulting from stewardship contracts, including forest restoration and fuel reduction thinning treatments, as well as traditional timber sales, are limited for various reasons, including small landing size and relatively small harvest volume per treatment unit. Logs produced from those treatments are often small (<12 in. dbh) in diameter, with a minor component of some large-diameter trees (>12 in. dbh). It becomes impractical or not economically viable to sort these materials at small landings while trying to maximize operational efficiency in those treatments. Small amounts of harvestable volume from each treatment unit make it difficult to justify intensive in woods sorting practices.

During the course of providing sort yard technical assistance, the authors have found a general lack of understanding of the basic principles of planning log sort yard projects. Deficiencies include poor layout and design, selecting the wrong merchandising and sorting equipment, inadequate consideration of the available log resource, lack of market planning and feasibility, poor siting, poorly developed financial analysis, and lack of sound business planning. Many of these deficiencies are rooted in (1) planning by subjective opinions instead of informed decisionmaking, (2) using poorly thought out assumptions, or (3) deficiencies in one or more of several critical factors to log sort yard success.

The direct benefits of log merchandising at a log sort yard have been generally recognized, and interest in commercial log sort yards has increased because of a decline in timber resource quality and availability, diversified log and fiber markets, and the need to recover more value from the available resources (Williston 1988, Dramm et al. 2002). Log sort yards provide benefits in (1) facilitating better utilization and marketing of logs through optimization in sorting logs for highest market values, (2) revitalizing forest-dependent rural

communities by offering a diversified and dependable supply of raw material (Sunderman 2003), and (3) providing options for effective marketing of underutilized small-diameter materials and woody biomass from fuel reduction thinning operations and timber sales (Dramm et al. 2002).

The value of the wood removed in fuel reduction thinning and restoration treatments can be enhanced if the trees are efficiently merchandised and logs are sorted for special products before delivery to the next manufacturing destination. However, past studies indicate that costs of operating a small-diameter log sort yard often outweigh the revenue generated by sorting and preprocessing those logs (Sedney 1992, Dramm et al. 2004, Sessions et al. 2005). Small-diameter logs often yield lower product value and cost substantially more to process on a per unit (volume) basis than large-diameter logs. For example, it takes about four times as many 6-in. small-end diameter logs to equal the same cubic volume found in 12-in. small-end diameter log of the same length (Barbour 1999). Small softwood logs also have relatively uniform log quality, leaving less opportunity to improve value recovery that may cover expenses incurred in preprocessing and sorting these logs into different grades (Dramm et al. 2002).

To make economically viable the running of a sort yard that handles mostly small-diameter logs, every consideration should be driven by the need to procure and process these logs at the lowest possible per unit cost (\$/green ton) while minimizing inventory and overhead costs. More specifically, the economics of sort yards are determined by several factors, including (Dramm et al. 2002) log procurement costs, including stumpage, harvest, and haul costs; processing and sorting costs; value recovery of log products sold; and logyard inventory cost, overhead charges, depreciation, and business taxes and fees.

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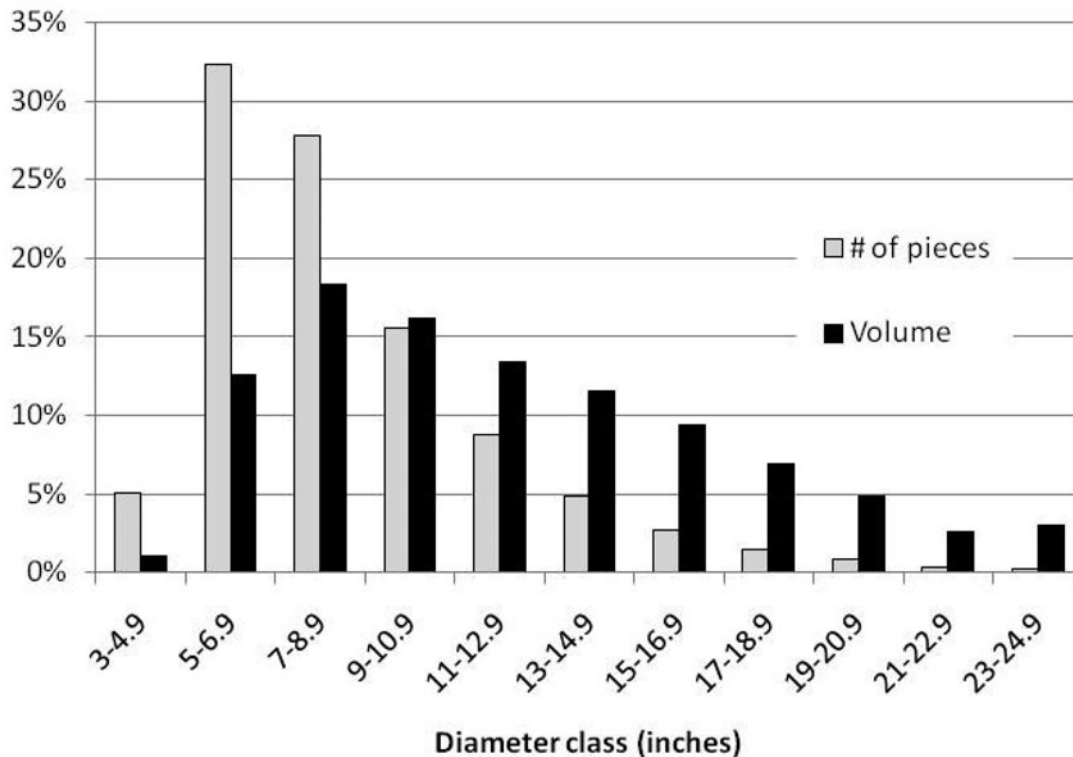


Figure 1. Number of pieces and volume distribution (%) by dbh class.

Log procurement costs and value recovery of log products are highly variable depending on local forest products industry conditions and resource availability, whereas log sort yard operating costs can be controlled by effective business and operations planning. The business objectives of a log sort yard should be clearly identified, and a preliminary evaluation of financial feasibility should be undertaken. A preliminary study lies somewhere between a “back of the envelope” calculation and a full business plan. A full business plan of running a log sort yard could be developed if the preliminary analysis of financial feasibility indicates a favorable return (Safranski and Kwon 1991, Howe and Bratkovich 2005).

The concept of a sort yard had been proposed in western Montana to (1) improve utilization of small logs from stewardship contracts including fuel reduction thinning and restoration treatments, (2) improve and expand local wood processing business by providing a steady supply of raw material, (3) process a mix of logs with various quality and wood properties to desired specifications for diverse wood processing firms, (4) provide inventory and sorting services, and (5) contribute to value added by allocation of resources to optimum end-uses.

With these objectives in mind, a team of US Forest Service and university researchers was assembled to conduct a market analysis for small-diameter log products and evaluate the potential costs and benefits of a merchandising and sorting system (log sort yard) in conjunction with a series of treatment and stewardship contracting scenarios on a landscape level in western Montana. As part of that overall project, this article presents the results of the prefeasibility financial analysis of the theoretical sort yard operation using actual empirical market and processing data. Given the uncertainties of resource supply, forest products market volatility, and financial viability of log sort yard operations, the specific objectives of this study were to (1) evaluate the financial prefeasibility of running a log sort

yard using the log sort yard cash flow analysis (LSY) model (Bilek 2009), (2) assess key cost and revenue factors that critically affect financial prefeasibility, and (3) examine cost components in log sort yard operations using empirical data.

Study Method

Supply of Logs and Sort Yard Product Output Values

For a log sort yard to be successful, the yard must have a steady supply of logs with varying desirable characteristics (size, species, grade, etc.) that are recognized in a marketplace. The size of the sort yard is determined in part by the available log supply, number of log sorts, log scaling method, and types of capital equipment that would be needed to efficiently handle logs (Dramm et al. 2002). A parallel study (Chung et al. 2010) has been conducted to evaluate how improved value recovery through various log sorting strategies would increase the residual value of forest health restoration treatments to landowners relative to a traditional sort at landing. To estimate the quantity of timber harvested from forest restoration thinning treatments, Chung et al. (2010) developed restoration thinning prescriptions specific to each forest type and simulated each prescription using the Forest Vegetation Simulator (Dixon 2003) and US Forest Service Forest Inventory and Analysis plot data. We used the following summary of log supply information from Chung et al.’s study:

- Thirty-three million board feet/year, or about 29 truck loads/day (4.5 thousand board feet [mbf]/truck load)
- Operating 250 days/year to handle 664,063 tree-length logs per year, or 2,656 pieces/day
- Small-diameter logs: 65% of logs produced from trees with dbh < 9 in.

Table 1. Delivered product output values (2007) by species and product types which include costs of hauling products from the log sort yard to markets in western Montana.

| Species | Product output | | | | | | |
|------------------|------------------------|----------|------------|-----------|---------------|-----------------------|-----------------------|
| | Sawlog | Stud log | Veneer log | House log | Post and pole | Pulp log ^a | Hog fuel ^a |
| | (\$/mbf ^b) | | | | | | |
| Ponderosa pine | 443 | | | | | 224 | 159 |
| Douglas-fir | | 354 | 444 | 1,471 | | 224 | 159 |
| Lodgepole pine | 443 | 354 | | 1,471 | 450 | 224 | 159 |
| Englemann spruce | 443 | 354 | | 1,471 | | 224 | 159 |
| Western larch | | 354 | 444 | | | 224 | 159 |
| Red cedar | 443 | | | | | | 159 |
| Subalpine fir | | 309 | | | | 224 | 159 |
| Grand fir | | 309 | | | | 224 | 159 |

^a Pulp log and hog fuel values were converted from \$36 and \$28 per green ton for calculation purposes, respectively.

^b mbf, thousand board feet.

- A mix of conifer species (value in parentheses indicates percentage of the total input volume of logs):
- Subalpine fir (AF; *Abies lasiocarpa*, 11.4%)
- Douglas-fir (DF; *Pseudotsuga menziesii*, 45.3%)
- Englemann spruce (ES; *Picea engelmannii*, 8.1%)
- Grand fir (GF; *Abies grandissima*, 1.3%)
- Lodgepole pine (LP; *Pinus contorta*, 20.0%)
- Ponderosa pine (PP; *Pinus ponderosa*, 12.6%)
- Redcedar (RC; *Thuja plicata*, 0.3%)
- Western larch (WL; *Larix occidentalis*, 0.9%)

In this feasibility analysis, the log supply (Figure 1) was based on the assumption that a whole tree harvesting method is used in fuel reduction and restoration treatment operations to effectively reduce fuel loading. Trees are felled and skidded to a landing, where they are processed to 2½-in. top diameter to produce logs up to 40 ft long that could be hauled using standard stinger-steered logging trucks. Log sorting at a landing is often limited during restoration thinning operations in US Forest Service and nonindustrial privately owned areas because of small volumes that are generated at small and narrow landings.

However, some presorting of material can be and frequently is done at the landing to improve the overall economics of merchandising and sorting. Presorting is typically limited to major sorts (separating pulpwood from high-valued logs) to improve the overall economics and efficiency of log merchandising and sorting. The concept is to minimize expensive double handling of lower-valued material (e.g., pulpwood). Pulpwood, including nonsawlog materials (i.e., woody biomass for energy), would be marketed directly to a pulp mill or energy plant from the landing, whereas all other logs (sawlogs, veneer and peelers) are sent to a log sort yard for further merchandising and sorting. Therefore, in our log supply analysis, we further assume that there would be an initial presort with two piles (pulpwood and sawlogs) of wood at landings.

A log sort yard would not be successful without diversified log markets that require logs with different characteristics (size, length, diameter, species, grade, etc.). We performed a market survey in western Montana to understand the 2007 market value and demand for raw materials of wood (e.g., sawlogs, veneer logs, and hog fuel). The market analysis indicated that there are seven major products that could potentially be produced and sold in western Montana (Table 1). The delivered product output values shown in Table 1 represent revenues that could be realized after making allowances for log hauling costs from the sort yard to each of the candidate markets. The same survey also found that a typical average value of nonsorted

logs that were produced from restoration thinning operations in western Montana in 2007 was around \$300/mbf, and this was the average log input value that is the price the sort yard pays for delivered logs. We used the following product specifications:

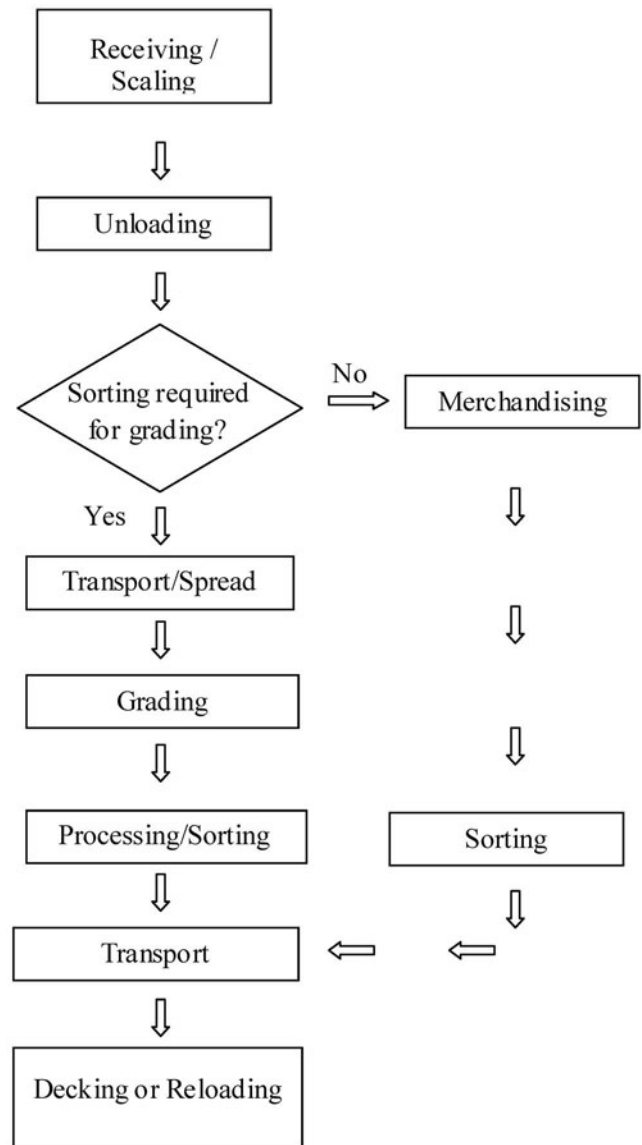


Figure 2. The basic functions of a log sort yard and the flow of log volumes through each process.

Table 2. Cost assumptions by equipment type used in the log sort yard.

| Capital equipment | Initial cost (\$) | GDS life (years) ^a | Economic life (hours) | Salvage value (\$) | Horsepower ^b | Operating hours (hours/shift) |
|--------------------------------|-------------------|-------------------------------|-----------------------|--------------------|-------------------------|-------------------------------|
| Front-end loader (CAT 980) | 559,000 | 5 | 10,000 | 55,900 | 318 | 9 |
| Front-end loader (CAT 966) | 377,000 | 5 | 10,000 | 37,700 | 262 | 5 |
| Cut-to-length processor (used) | 200,000 | 5 | 10,000 | 20,000 | 215 | 5 |
| Tracked loader (CAT 325d FM) | 438,000 | 5 | 10,000 | 43,800 | 204 | 9 |
| Log merchandising system | 550,000 | 5 | 15,000 | 55,000 | 150 | 9 |
| Grinder (Peterson 2710C, used) | 150,000 | 5 | 5,000 | 15,000 | 475 | 2 |

^a General depreciation system (GDS): equipment's depreciable life under the rules of the Internal Revenue Service.

^b Diesel fuel and oil costs used were \$4.25/gallon and \$8.00/gallon, respectively.

- Sawlogs (PP, LP, ES, RC): 6-in. minimum small-end diameter
- House logs (DF, LP, ES, WL): 8-in. minimum small-end diameter and 20% or less moisture content, standing dead trees
- Stud logs (DF, LP, ES, WL, AF, GF): 4.5-in. minimum small-end inside bark diameter
- Veneer logs (DF, WL): 7.5-in. minimum small-end diameter
- Post and pole (LP): 3-in. minimum small-end diameter
- Pulpwood (LP, DF, LP, ES, WL, AF, GF): 2.5-in. minimum small-end diameter
- Hog fuel (any woody material that results from the handling and merchandizing of logs at a log sort yard that is not salable for other products)

An Overview of Log Sort Yard Operation

Log sort yard design considerations and operations are highly dependent on the volume and number of logs to be handled, sorting and processing requirements, and inventory options. Based on the log supply information, we concluded that a medium-sized dry sort yard (unsurfaced, 40 ac), as described by Sinclair and Wellburn (1984), would efficiently handle up to 250 mbf/day of log volume. The basic functions of a log sort yard include receiving/scaling, unloading, transport, grading, merchandising, sorting, reloading, and log storage/inventory (Figure 2). Log sort yard equipment for each function was selected on the basis of the equipment selection guide from Dramm et al. (2002) and personal communications with log sort yard operators and forest products professionals.

Receiving and Scaling

Tree-length logs arrive at a sort yard and are purchased on a weight scale basis because 65% of logs are produced from the trees with dbh less than 9 in. One out of every the 10th truck load may be check scaled (load is spread out and stick scaled) to determine log volume to weight relationships and log quality and diameter distributions. A mixed load of small and large logs may also require more effort in spreading, grading, and sorting of individual logs.

Unloading

One front-end loader (CAT 980-size) makes multiple passes (three to six cycles) to unload a logging truck after weight scaling of logs. It is necessary to bring the loaded truck into the middle of the yard to minimize unloading time, and it would take a little over 10 minutes for a skilled operator to complete unloading (Sinclair and Wellburn 1984). Another front-end loader (CAT 966) provides assistance in unloading process, as well as handling other miscellaneous tasks, such as cleaning the yard and transporting sorted logs to storage decks.

Transporting and Spreading

The CAT 980 front-end loader picks up logs from the logging truck (i.e., unloading) and transports the logs to grading/sorting area. In case that logs are directly fed into a merchandiser, the front-end loader transports the logs to the feeding deck area of the merchandiser.

Grading

Short logs and mixed log loads (species, wide range of log diameters) arriving in the yard may require sorting prior to merchandising. Grading logs (i.e., marking logs for sorting) is an essential step to improve log values and effectively use logs for a particular use. This begins by spreading out the logs to facilitate the grading process and determine the best use of each log.

Merchandising (Bucking and Sorting Tree-Length Small-Diameter Logs)

Small logs (<12 in. in diameter) go through merchandising (bucking and sorting) to be processed into six log products (sawlogs, stud logs, veneer logs, house logs, post and pole, and pulp log). For the purpose of our data analysis, we selected the Precision Sawmill System, which can be programmed up to 10 different cut lengths, based on the digital read of log length and diameter. Wood residues and trim ends (smallwood chunks) are ground and sold as hog fuel to the market.

Processing/Sorting (Merchandising Medium to Large Logs)

For somewhat larger diameter (>12 in.) tree-length logs, a cut-to-length (CTL) processor is used to merchandise (buck and sort) the logs. After logs are first spread and graded in the sorting bay, each log is individually processed by the CTL processor to recover the highest value of log products, which are the end sort categories. The area required for sorting increases with the number of sorts (seven in our study) and the volumes/pieces processed per shift (2,422 pieces/shift in our study). Using the graph that is used to estimate the area required for sorting (Sinclair and Wellburn 1984), we estimated that 10 ac would be needed to handle the sorting requirements.

Decking/Reloading

Although log inventory should be kept to a minimum, some log storage is necessary. Logs are decked in the yard to temporarily provide surge for unsorted logs and to accumulate enough sorted logs for loads. This allows addressing the unbalanced tasks between machines and improving safety in the yard, as well as providing a steady supply of raw material to local wood processing business.

Table 3. Summary of financial indicators over the 10-year project planning period.

| | Net present value (\$) | Nominal IRR ^a | Real IRR ^b |
|-------------------------------------|------------------------|--------------------------|-----------------------|
| Before finance and tax ^c | 2,891,150 | 28.9 | 25.1 |
| Before tax ^c | 3,103,599 | 41.1 | 37.0 |
| After tax ^d | 2,380,993 | 28.0 | 24.3 |

^a Internal rate of return (IRR) including an inflation rate (3%).

^b Internal rate of return (IRR) over and above an inflation rate (3%).

^c Net present values before finance and tax and before tax are discounted at 11.6%.

^d Net present value after tax is discounted at 7.0%.

Both the CAT 980 front-end loader and CAT 325D log loader are used to load trucks.

Grinding Wood Residues and Logyard Debris

We estimate that the volume of wood debris is, on average, 5% of the log volume processed through the yard (Sinclair and Wellburn 1984). This includes log tops and wood chunks that result from log merchandising or log breakage, as well as sawdust and bark. A medium-size (475 hp) grinder (bought used) is used to convert this wood debris into hog fuel, which is stored on a paved pad. Hog fuel is sold to locally energy plants, sawmills, or other wood energy using facilities.

Log Sort Yard Financial Analysis

The financial analysis was performed using the LSY model (Bilek 2009). LSY is an integrated financial model that provides 10-year cash flows and before- and after-tax net present values, internal rates of return (IRR), and other financial information. The model includes the following cost and revenue items: log input volumes and costs; revenues from marketing various products; capital investments on equipment and tools; equipment operating costs, including replacements; land purchase or leasing cost; construction costs; deconstruction costs (if needed); labor (hourly workers and salary-

based administrative workers); and financial costs (e.g., interest payments and working capital requirements).

The LSY model can also be effectively used for break-even and sensitivity analysis to estimate maximum log procurement costs that maintain a desired return on investment. We performed our financial analyses on the basis of a 10-year project period because many machines used in a log sort yard need to be replaced or refurbished within 10 years. Furthermore, the forest products business sensitively responds to market conditions, and a financial analysis of a log sort yard over an extended period (>10 years) would not be informational. We used a weighted average nominal before-tax discount rate of 11.6% to calculate before-tax present values. Taxes were estimated on the basis of a combined state and federal income tax rate of 39.7%. Labor costs include charges for 12 hourly wage employees and the four salaried employees. The estimated costs for equipment used in a log sort yard handling small-diameter logs are summarized in Table 2.

Results and Discussion

Financial Feasibility of Running a Log Sort Yard

Based on the log input and commercial equipment data supplied, the financial feasibility of a log sort yard processing a mix of mostly small-diameter logs in western Montana looks promising (Table 3). The project's internal rate of return was 24.3% after accounting for inflation and income taxes from the log sort yard business given our assumptions. The present value of additional after-tax profits was about \$2.38 million. Of greater concern, however, was the sensitivity of the financial feasibility of running a log sort yard to changes in operational factors, including costs, revenues, and log supply. A way of measuring the importance of costs in a business enterprise is to divide them by sales revenue. The larger the percentage of costs in relation to total sales revenues, the more sensitive net profits (or losses) will be to changes in those costs.

The delivered log input cost (\$300/mbf) represents 78.1% of the total sales revenues that would be earned by the proposed sort yard

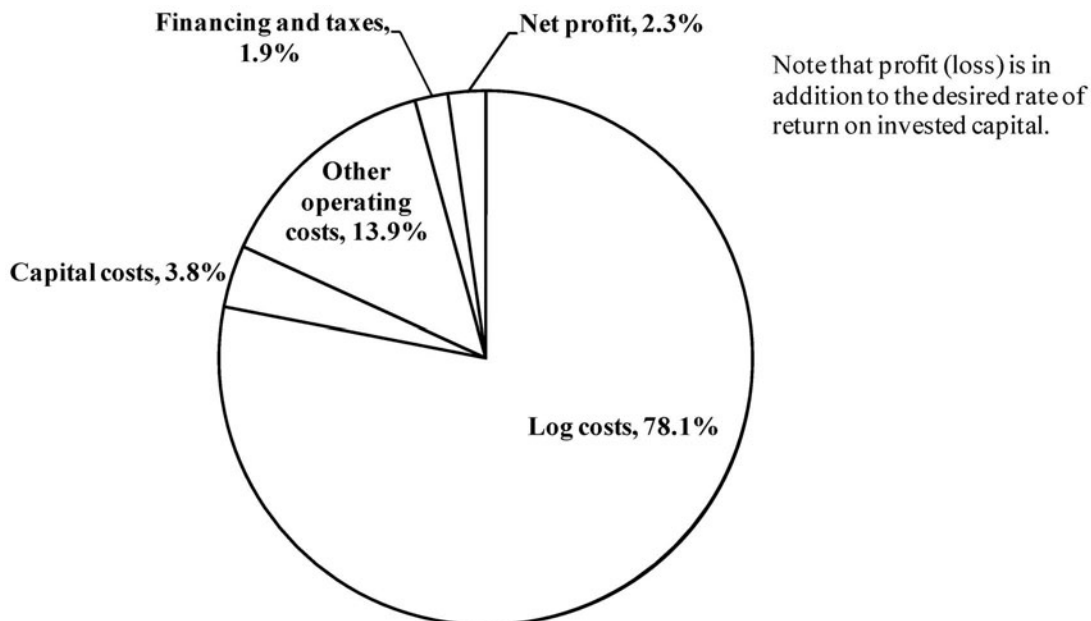


Figure 3. Log sort yard discounted after-tax costs and net profit as a portion of discounted sales revenue. Other operating costs include direct production cost, fixed costs and overhead, and working capital (Table 4).

Table 4. Summary of cost and revenue resulted from running a log sort yard in western Montana.

| | After-tax present value (\$) | Revenue and costs | | Proportion of sales (%) |
|-------------------------------------|------------------------------|-------------------------|-----------------------|-------------------------|
| | | (\$/piece) ^a | (\$/mbf) ^b | |
| Gross revenue | | | | |
| Sales revenue | 104,665,594 | 21.18 | 404.52 | 100.0 |
| Log input costs | -81,706,863 | -16.53 | -315.79 | -78.1 |
| Subtotal | 22,958,731 | 4.65 | 88.73 | 21.9 |
| Operating costs | | | | |
| Capital cash flows | -3,954,798 | -0.80 | -15.28 | -3.8 |
| Direct production costs | -10,671,941 | -2.16 | -41.25 | -10.2 |
| Fixed costs and overheads | -3,451,125 | -0.70 | -13.34 | -3.3 |
| Working capital | -410,751 | -0.08 | -1.59 | -0.4 |
| Subtotal | -18,488,615 | -3.74 | -71.46 | -17.7 |
| Financing, capital gains, and taxes | | | | |
| Financing cash flows | -93,051 | -0.02 | -0.36 | -0.1 |
| Capital gains and income taxes | -1,996,072 | -0.40 | -7.71 | -1.9 |
| Subtotal | -2,089,123 | -0.42 | -8.07 | -2.0 |
| Net profit (loss) | 2,380,993 | 0.48 | 9.20 | 2.3 |

^a Values based on input volume.

^b Values based on output volume. mbf, thousand board feet.

over a 10-year period (Figure 3 and Table 4). The percentage of delivered log input costs to the total cost is quite sensitive to the price change for the logs being delivered to the log sort yard. This explains why the real after-tax IRR would sharply decrease with increases of the average delivered log input costs, shown in Figure 4, and reinforces the importance of procuring logs at the lowest possible per unit cost. The maximum break-even log input cost, which is the average cost at which the owners receive exactly their desired rate of return, would be \$314.53/mbf in year 0.

The second largest cost factor would be the sort yard operating cost (\$79.53/mbf or \$3.74/piece), which would represent 17.7% of the total sales revenue (Figure 3 and Table 4). Within the operating cost, the direct production costs (\$41.75/mbf), including wages for hourly employees and machine operating cost, share the largest component (10.2% of the total sales revenues), followed by the capital investment (\$15.28/mbf) in major equipment (3.8% of the

total). The operating cost could be controlled and minimized through well-designed project planning and efficient operations. For example, a used grinder (\$150,000) would not be necessary if the residues generated from wood processing were contracted to a local firm, and this might lower the operating cost.

The real after-tax IRR would also be quite sensitive to the changes of revenues that the log sort yard would earn from selling output products (Figure 5). For example, the real after-tax IRR would decrease to negative 3.4% or increase to 48.1% if the revenue dropped or increased by 5%, respectively. We also found from the breakeven analysis that the log sort yard as configured should annually process at least 22,709 mbf of logs to earn the minimum after-tax required rate of return on investments. This would also mean that the yard must operate at 68% of its full-time capacity, or 170 shifts per year. These results indicate that accurate information regarding wood market conditions and local log supplies is a prerequisite to understanding the true financial viability of a log sort yard.

Over the 10-year project planning period, annual cash flows were projected to be positive from the second year of the project, except in year 6 (2013), when a major expense would be incurred to replace the equipment that has a 5-year economic life (Figure 6). This would be a critical time to do a major reassessment of the yard's ongoing financial feasibility. Another critical time would be in year 8 (2015) when equipment with an estimated 7-year economic life is scheduled for replacement (Figure 6).

Product Value Recovery at the Log Sort Yard

Gross margin is the difference between the sales revenues received for the log products and the delivered log input costs. It represents what is left over to cover all other costs, including variable processing, capital, administration, financing, etc. The log sort yard would make its largest margins by handling Douglas-fir (Figure 7 and Table 5). This species accounts for 45% of the total volume and produces high-value products, such as stud, house logs, and veneer logs. In contrast, subalpine fir and grand fir would have negative gross margins, at an input cost of \$300/mbf. This means that the yard would be losing money by processing these latter species.

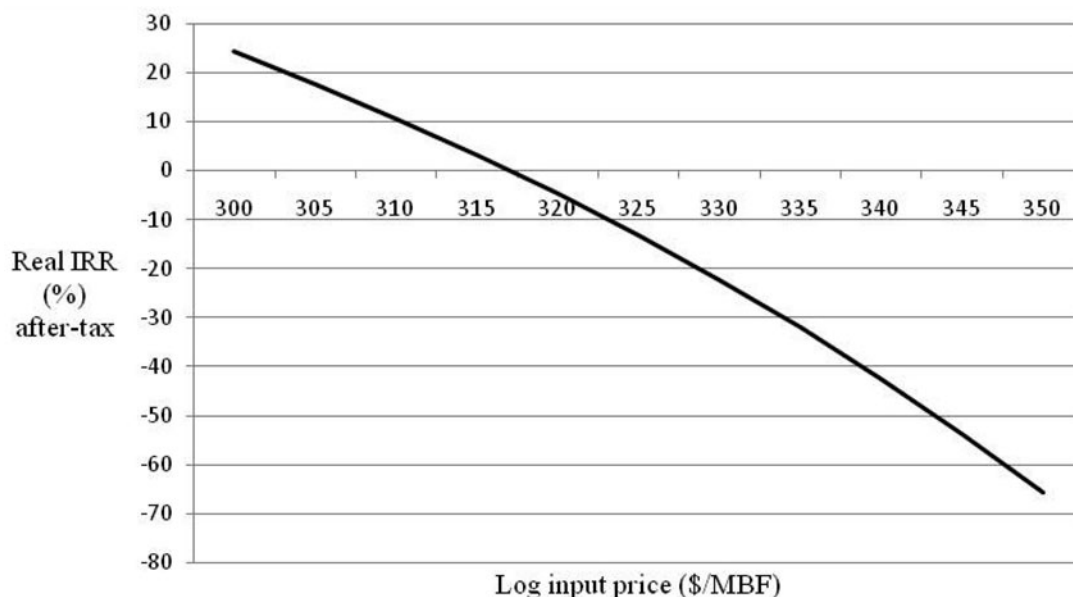


Figure 4. Change of real internal rate of return (IRR; %) after tax over different delivered log input prices (\$/thousand board feet [MBF]).

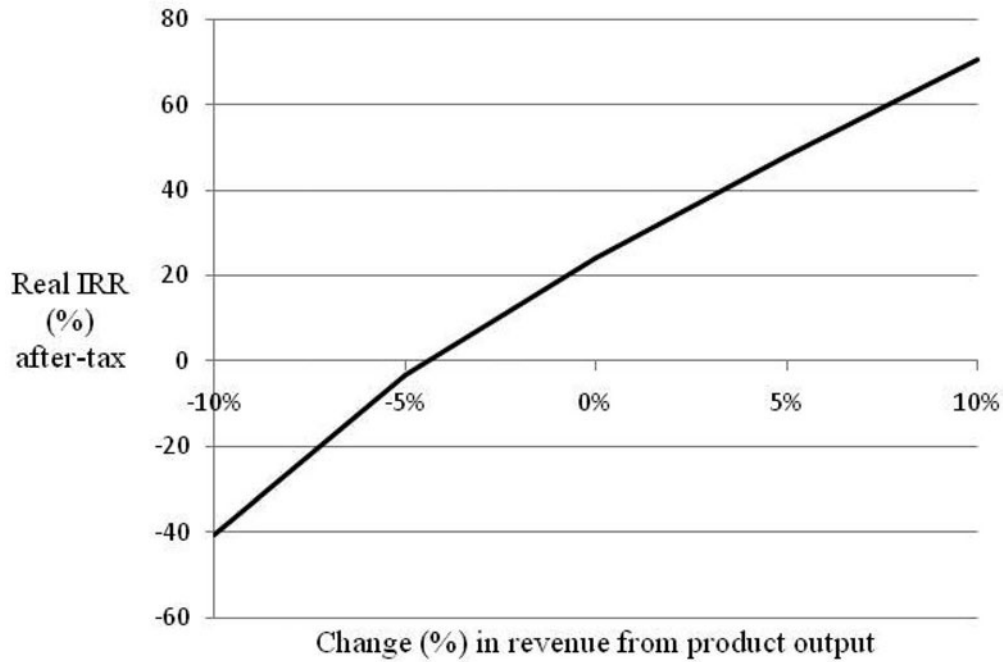


Figure 5. Change of real internal rate of return (IRR; %) after tax with percentage change in product revenue. The percentage change represents increase or decrease of the revenue from selling products to the market with the delivered log input price set to \$300/thousand board feet.

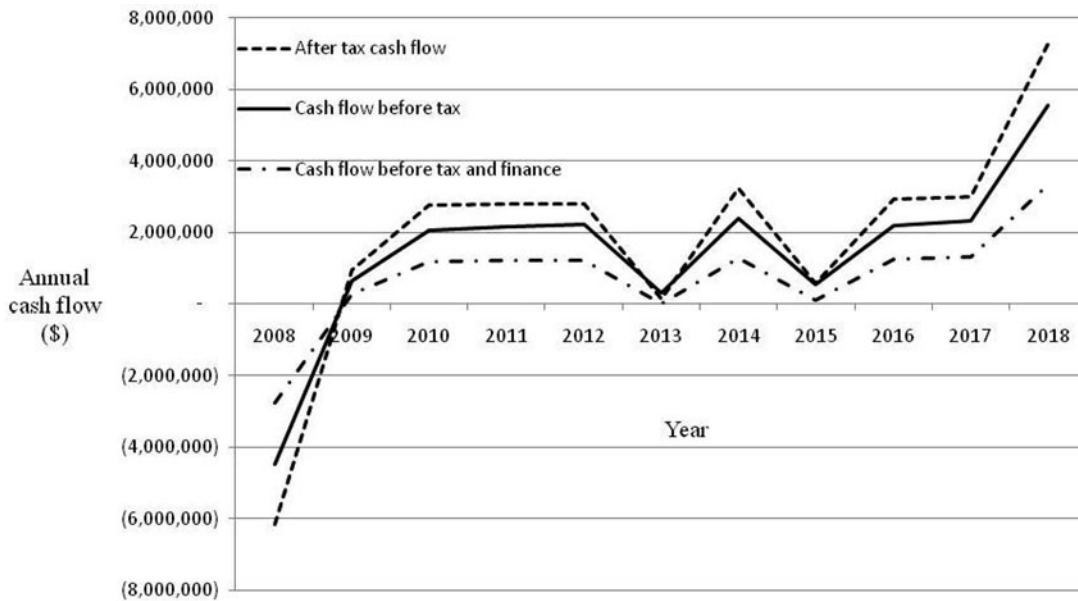


Figure 6. Annual cash flows over the 10-year project planning period.

Veneer logs and sawlogs provide the highest values and make the largest contribution to gross margin (Figure 8). Post and poles also generate a positive contribution to the gross margin. Pulp log and hog fuel would cause large losses if these were the primary products for logs delivered to the yard. That is the reason that these products should be presorted and delivered directly to market from the forest landing. These low-valued products are inevitably produced as a result of the yard's merchandising process, but their production should be minimized.

Looking at the products by their contributions to unit gross margin, house logs look even more profitable than veneer logs (Ta-

ble 6). However, house logs would make up only 0.2% of the yard's total volume output. If the yard could produce more house logs, or if the yard could develop more markets for house logs if market demand is the limiting factor, then this would represent a possible opportunity for the yard to improve its overall profitability. Looking at these products' contributions in another way, if these higher-valued logs were removed in a presort from the sort yard's log input mix, then the yard's financial viability would be threatened.

The success of any log sort yard greatly depends on the ability of the yard to either fill a marketplace function that is not currently being filled, or perform a function more efficiently than the systems

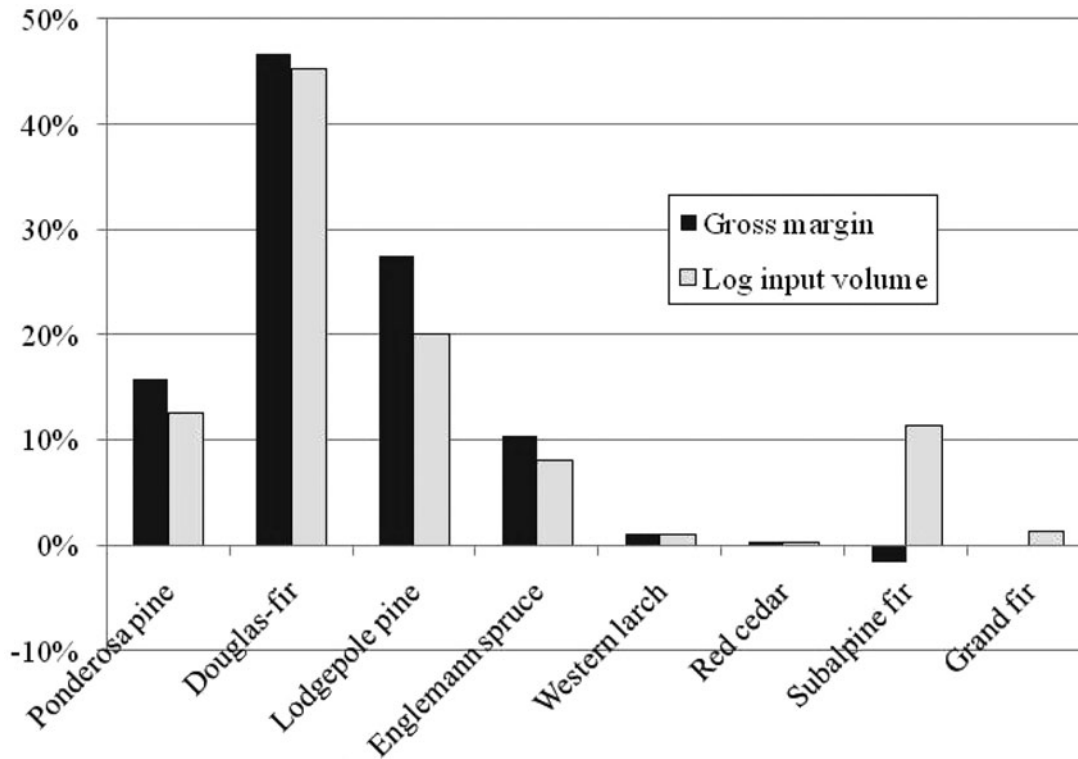


Figure 7. Input log grade contributions to the total gross margin.

Table 5. Unit value recovery by species at year 1.

| Species | Value gain or loss (\$/mbf) ^a | Contribution to the gross margin (%) |
|------------------|--|--------------------------------------|
| Ponderosa pine | 114.49 | 15.8 |
| Douglas-fir | 94.30 | 46.8 |
| Lodgepole pine | 125.41 | 27.5 |
| Engelmann spruce | 118.06 | 10.4 |
| Western larch | 99.26 | 1.0 |
| Red cedar | 99.73 | 0.3 |
| Subalpine fir | -13.57 | -1.7 |
| Grand fir | -10.40 | -0.2 |

^a mbf, thousand board feet.

currently in place. Logs are probably being sorted somewhere in western Montana already, either on log landings or perhaps in mill yards. If these are inefficient operations or if there is waste in these operations (e.g., by using higher-grade logs for lower-grade uses), then there may be an opportunity for a specialized log sort yard to perform this function more economically and provide a more efficient market for logs. In such circumstances, a logyard would be able to pay a bit more for logs or sell them for a bit less than current market conditions dictate and make up its margin by having tighter product specifications and lower-cost sorting. However, the yard's manager must always be aware of what the alternative markets are and also be aware of what the alternative systems are to keep the log supplies coming and thereby to fill a market need.

This preliminary analysis of financial feasibility should be further refined and updated with the objective of developing financial analysis for a full business plan before any investment takes place. Investors would need assurance that log supplies from federal lands will be there through stewardship contracts in place and that projects have cleared the National Environmental Protection Act (National Environmental Policy Act of 1969) standards. Prices should be up-

dated to account for the recent downturn in wood markets. The yard's location should be refined so that transportation costs can be more accurately estimated. Location on a rail head would further change the location economics, although these factors could easily be incorporated into the planning model. If a yard were located near an urban area, there may be opportunities to accept urban logs for a tipping fee. Such factors can also be incorporated into the planning model.

Conclusion

The financial feasibility of a log sort yard that processes primarily small-diameter logs largely depends on prices that the yard needs to pay and product revenues that the yard would receive from selling product outputs. Under most scenarios, delivered log input prices represent two-thirds to three-quarters or more of the total log sort yard cost, and it is critical for a log sort yard to procure logs at a minimum cost to be successful. The operating cost of a log sort yard represented 17.7% of the total cost, including the direct production cost (10.2% of the total cost) and capital investment on major equipment (3.8% of the total). The projected log sort yard operating costs of \$3.74/piece or \$79.53/mbf indicate the magnitude of value that must be added by the sort yard operation in order for it to be financially viable. A well-designed log sort configuration that effectively reflects delivered log input supply and product market conditions not only allows efficient sort yard operations but also reduces requirements for initial capital investments.

The direct benefits of log merchandising at a sort yard could be accomplished by maximizing revenues that cover all the log sort yard costs and generate profits as a result of the sort yard operation. Species and product types are important factors determining gross revenues. Douglas-fir, accounting for 45% of the total volume, generates the largest margins by sorting and merchandising those logs in

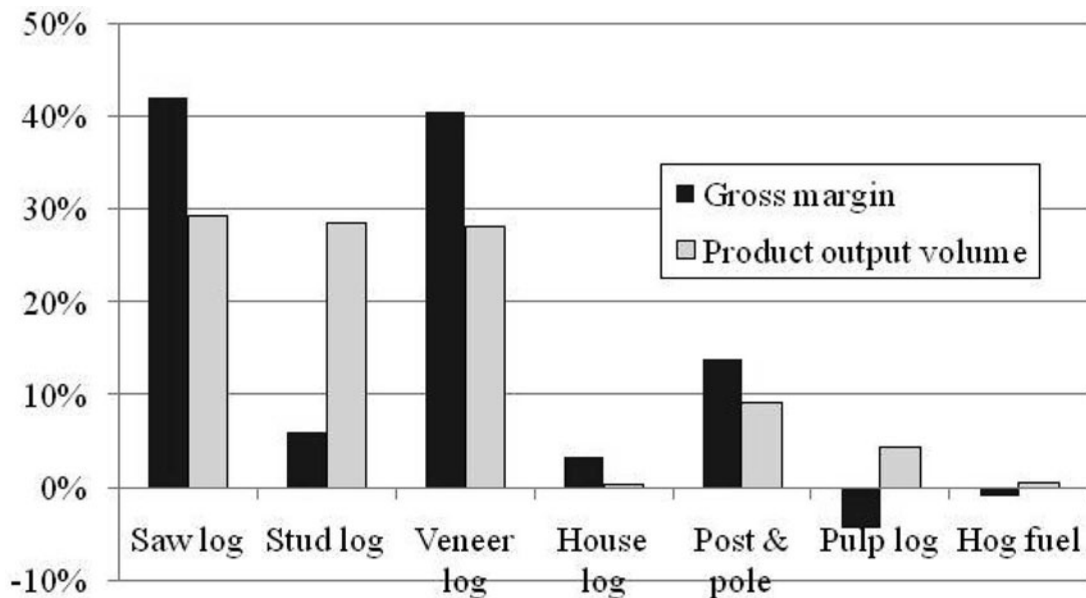


Figure 8. Output log grade contributions to the total gross margin.

Table 6. Unit value recovery by output product types at year 1.

| Output product types | Value gain or loss (\$/mbf) |
|----------------------|-----------------------------|
| Saw log | 131.03 |
| Stud log | 19.36 |
| Veneer log | 132.06 |
| House log | 1,189.87 |
| Post and pole | 138.24 |
| Pulp log | -94.54 |
| Hog fuel | -161.49 |

a log sort yard. Subalpine fir and grand fir have negative gross margins at an input cost of \$300/mbf. Sawlogs made the highest contribution to the total gross margin (42%), followed by veneer logs (40%) and post and pole (14%). House logs generated the highest individual product profit margin, but the total volume of house logs represented only 0.2% (or 3% of the gross margin).

It would be critical for management to closely monitor log costs as well as gross margins on both log species groups and products to ensure that the yard adds value and not just cost to the logs that it processes. It should be further noted that the success of any log sort yard would be highly dependent on the ability of the yard to fill a function of improving value recovery and utilization that is not being realized in the marketplace. A sustainable supply of logs to a sort yard for extended years is not part of this study, but it remains as an important question that is difficult to answer.

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