Financial feasibility of a log sort yard handling small-diameter logs

Han-Sup Han
Humboldt State University, Arcata, California
Email: hh30@humboldt.edu

Ted Bilek and Rusty Dramm
USDA Forest Products Laboratory, Madison, Wisconsin

Dan Loeffler
College of Forestry and Conservation
The University of Montana – Missoula

David Calkin
USDA Forest Service, Rocky Mountain Research Station, Missoula, Montana

The value 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. However, past studies indicated that costs for running a log sort yard for small-diameter logs could outweigh the revenue generated by sorting and pre-processing those logs. This study was to evaluate the financial feasibility of running a log sort yard that serves as a log market to buy and sell small-diameter logs in western Montana. We modeled a log sort yard to process and sort small-diameter logs to seven products (sawlogs, house logs, stud logs, peeler logs, post & pole, pulpwood, and hog fuel). The financial feasibility of a log sort yard would largely depend on prices that the yard pays and product revenues that the yard receives from selling sorted and processed logs. The delivered log input costs represent 78.1% of the total sales revenue while the yard's operating costs account for 17.7% of the revenue. The log sort yard operating cost was $3.85/piece or $71.46/MBF. Species and product types were important factors determining gross revenues. Douglas-fir would make the biggest contribution to the yard's gross margin since this species both represents the largest volume (45% of the log) into the log sort yard and produces high value products (house logs and veneer logs).

Introduction

The value of the trees removed in fuel reduction thinning and restoration treatments can be enhanced if the wood can be effectively evaluated and sorted for quality and highest value 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 pre-processing those logs (Sessions et al. 2005; Dramm et al. 2003; Sedney 1992). 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-inch small-end diameter logs to equal the same volume found in 12-inch 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 pre-processing and sorting these logs into different grades (Dramm et al. 2002).

Log procurement costs and value recovery of log products are highly variable depending on local economic conditions in the forest products industry and resource availability, while log sort yard costs can be somewhat controlled by effective business and operations planning. The operational objectives of a log sort yard should be clearly identified, and then a proper business plan needs to be developed (Howe and Bratkovich 1995, Safranski and Kwon 1991). In our study, a sort yard is proposed to 1) improve utilization of small logs from fuel reduction thinning and restoration treatments; 2) process a mix of logs with various quality and wood properties to desired specifications for diverse wood processing firms; 3) improve and expand local wood processing business by providing a consumer-specified supply of raw material to optimum end-uses; and 4) provide inventory and sorting services.

Under these objectives, a team of USDA Forest Service and university researchers was assembled to conduct a market analysis for small wood and forest biomass-based products and evaluate the costs and benefits of a centralized processing and sorting system (i.e. log sort yard) in conjunction with a series of fuel reduction treatment scenarios on a landscape level. The specific objectives of this study were to evaluate:

- the financial feasibility of running a log sort yard
- factors critically affecting financial feasibility
- sensitivity analyses on key cost and revenue factors, and
- cost components in log sort yard operations

Log Supply

In order for a log sort yard to be successful, it must have a steady supply of diverse logs with varying characteristics that are recognized in the marketplace (e.g. size, species, grade, etc.). The projected log supply also helps to dictate the size of the sort yard and the type of capital equipment it should employ to handle logs efficiently. The log supply information has been developed by a group of researchers in the USDA Forest Service Rocky Mountain Research Station in Missoula and the University of Montana, based on the projected fuel reduction thinning treatment scenarios in western Montana. The following summary of log supply information was used for this study:

- 31,000 thousand board feet (MBF) per year or 27 truck loads/day (4.5 MBF/truck load)
- Operating 250 days/year; 664,063 tree-length logs per year or 2,656 pieces/day.
- Small-diameter logs: 65% of logs produced from the trees with diameter at breast height (DBH) less than 9 inches.
- A mix of conifer species: value in ( ) indicates percentage of the total input volume of logs.

- subalpine fir (*Abies lasiocarpa*, 11.4%)
- Douglas-fir (*Pseudotsuga menziesii*, 45.3%)
- Englemann spruce (*Picea engelmannii*, 8.1%)
- grand fir (*Abies grandissime,* 1.3%)
- lodgepole pine (*Pinus contorta*, 20.0%)
- ponderosa pine (*Pinus ponderosa*, 12.6%)
- red cedar (*Thuja plicata*, 0.3%)
- western larch (*Larix occidentalis*, 0.9%)

Sort yard Operations and Financial Analysis

Log sort yard design considerations and operations highly depend on the volume and number of logs to be handled, sorting and processing requirements, and inventory options. Based on the log supply information, a medium size sort yard as defined by Sinclair and Wellburn (1984) would efficiently handle up to 250MBF/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. Log sort yard equipment for each function was selected based on the equipment selection guide from Dramm et al. (2002) and personal communications with log sort yard operators and forest products professionals The financial analysis was performed using the Log Sort Yard Cash Flow Analysis (LSY) model (Bilek, 2008). LSY is an integrated financial model which provides ten-year cash flows and before- and after-tax net present values (NPV), internal rates of return (IRR) and other financial information. It can also be effectively used for break-even and sensitivity analysis to estimate maximum log procurement costs that maintain a desired return on investment. The assumptions shown in Tables 1 and 2 were made to perform the financial analysis of a log sort yard handling small-diameter logs.

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.

	Product Output Name						
	Saw log	Stud log	Veneer log	House log	Post & pole	Pulp log	Hog fuel
Log Species	($/MBF)						
Ponderosa pine	443	-	-	-	-	224	159
Douglas-fir	-	354	444	1,471	-	224	159
Lodgepole pine	443	354	-	1,471	450	224	159
Engleman spruce	443	354	-	1,471	-	224	159
Western larch	-	354	444	1,471	-	224	159
Red cedar	443	-	-	-	-	-	159
Subalphine fir	-	309	-	-	-	224	159
Grand fir	-	309	-	-	-	224	159

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

Capital equipment name	Initial cost ($)	GDS life (years)	ADS life (years)	Economic life (hours)	Economic life (years)	Salvage value ($)	Horse power	Operating hours (hrs/shift)
Front end loader (CAT 980)	559,000	5	6	10000	5	55,900	318	9
Front end loader (CAT 966)	377,000	5	6	10000	7	37,700	262	5
Cut-to-length processor (used)	200,000	5	6	10000	5	20,000	215	5
Tracked loader (CAT 325d FM)	438,000	5	6	10000	5	43,800	204	9
Log merchandising/sorting system	550,000	5	6	15000	7	55,000	150	9
Grinder (Peterson 2710C - used)	150,000	5	6	5000	7	15,000	475	2

Notes: - GDS life: equipment's depreciable life under the Internal Revenue Service (IRS)
- ADS life : equipment's depreciable life under the IRS
- Diesel fuel cost: $4.25/gallon; Oil cost: $8.00/gallon

Results and Discussion

Financial feasibility of running a log sort yard

Based on the log input and commercial equipment data supplied, the preliminary financial feasibility of a log sort yard processing a mix of mostly small-diameter logs in western Montana looks promising. The financial indicators are shown (Table 3).

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

	Net present value ($)	Nominal[1] IRR (%)	Real IRR[2] (%)
Before finance & tax[3]	2,891,150	28.9%	25.1%
Before tax[3]	3,103,599	41.1%	37.0%
After tax[4]	2,380,993	28.0%	24.3%

[1] Internal rate of return including an inflation rate (3%)
[2] Internal rate of return over and above an inflation rate (3%)
[3] Net present values before finance & tax and before tax are discounted at 11.6%
[4] Net present value after tax is discounted at 7.0%

An investor would earn a 24.3% internal rate of return after accounting for inflation and income taxes from the log sort yard business under the assumptions that were made in the economic analysis including an average delivered log input value of $300/MBF. The present value of additional after-tax profits is about $2.38 million. This present value is in addition to the calculated weighted average nominal after-tax return on capital of 7.0%. The importance of the various cost factors could be seen by looking at their relative importance with respect to sales revenues since all costs must first be deducted from revenues before profits can be determined. At $300/MBF, the delivered log input cost represents 78.1% of the total sales revenues earned by the proposed sort yard over a 10-year period (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 sharply decreases with increases of the average delivered log input costs, and reinforces the importance of procuring logs at the lowest possible per unit cost.

The second largest cost factor was the sort yard operating cost, which represents 17.7% of the total sales revenue (Table 4). Within the operating cost, the direct production cost 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 ($2,274,000 at Year 0) in major equipment (3.8% of the total). It should be noted, however, that equipment should be selected to reflect the work load for each piece of equipment and put together in a system that will perform its function at high efficiency and minimum cost. While the operating cost could be controlled and minimized through well-designed project planning and efficient operations, delivered log input prices and product output prices normally depend on market conditions (i.e. beyond an investor's control). Fixed and overhead costs in Table 7 include land & building, labor for salaried employees, and other administrative expenses.

Table. 4. Summary of cost and revenue.

	After-tax present value ($)	Values based on input volume ($/piece)	($/MBF)	Percent of sales (%)
Gross revenue				
Sales revenue	104,665,594	21.18	384.30	100.0
Log input costs	-81,706,863	-16.53	-300.00	-78.1
Subtotal (gross margin):	22,958,731	4.65	84.30	21.9
Operating costs				
Capital cash flows	-3,954,798	-0.80	-14.52	-3.8
Direct production costs	-10,671,941	-2.16	-39.18	-10.2
Fixed costs and overheads	-3,451,125	-0.70	-12.67	-3.3
Working capital	-410,751	-0.08	-1.51	-0.4
Subtotal:	-18,488,615	-3.74	-67.88	-17.7
Financing, capital gains,and taxes				
Financing cash flows	-93,051	-0.02	-0.34	-0.1
Capital gains and income taxes	-1,996,072	-0.40	-7.33	-1.9
Subtotal:	-2,089,123	-0.42	-7.67	-2.0
Net profit (loss)	2,380,993	0.48	8.74	2.3

Product value recovery at the log sort yard

The yard would make its largest margins by handling Douglas-fir. This species accounts for 45 percent of the total volume but 46.8 percent of the total gross margin. In contrast, subalpine fir and grand fir had negative gross margins at an input cost of $300/MBF. This means that the yard would be losing money by processing these species. Veneer logs and sawlogs should be the first choice to produce since these products allow recovering highest values and makes the largest contribution, representing 40% and 42% of the gross margin, respectively. Post & pole also generate a positive contribution (14%) 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. These low-valued products will be inevitably produced as a result of the yard's merchandising process, but their production should be minimized as much as possible.

Log sort yard operating costs

The proposed log sort yard operating cost based on pieces handled is projected to be $3.74/piece or $71.46/MBF including volume loss due to log breakage and processing loss. The proposed western Montana log sort yard should generate net revenues greater than $71.46/MBF to be financially feasible. At current log input price ($300/MBF) and market product prices, all the species (except subalpine fir and grand fir) coming into the log sort yard would generate net profit greater than $71.46/MBF. This result further emphasizes that log input price and product market value would greatly influence on the economic feasibility of a log sort yard.

In the proposed yard, direct production costs account for $41.25/MBF, or nearly 60% of the operating costs, and these direct production costs are split closely between equipment operating costs (not including labor) of $17.83/MBF and total hourly wages and employee accessories costs of $23.42/MBF. Capital cost ($15.28/MBF), fixed costs and overhead (13.34/MBF) and working capital ($1.59/MBF) make up the remaining to $71.46/MBF. It should be noted that log input prices and log output market values may not be controlled, but operations efficiency in the proposed log yard should be maximized to lower total operating costs.

Conclusion

The financial feasibility of a log sort yard that processes primarily small logs largely depend 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. It was further noted from the breakeven analysis that under the initial cost analysis and assumptions for the log market at the time of this analysis in western Montana, a medium-sized log sort yard should annually process at least 22,709 MBF of logs to earn the minimum after-tax required rate of return (7.0%) on investments.

The direct benefits of log merchandising at a centralized sort yard could be accomplished maximizing revenue to 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 percent of the total volume, generates the largest margins (46.8% of the total gross margin) by sorting and merchandising those logs in a log sort yard. Subalpine fir and grand fir have negative gross margin 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 & 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).

Preliminary financial feasibility analysis for a log sort yard in western Montana processing largely smaller-diameter logs indicates that such a yard might be successful. Given the assumptions used in our analysis, the financial indicators of net present value and internal rate of return are favorable. The projected log sort yard operating costs of $3.74/piece input or $71.46/MBF indicate the magnitude of value that must be added by the sort yard operation in order for it to be financially viable. These cost figures suggest that the financial viability of a log sort yard handling mainly small-diameter logs (less than 10 inches in large-end diameter) in western Montana would be a challenge to achieve, although it looks possible under the assumed

market conditions. It should be further noted that the success of any log sort yard would be highly depend on the ability of the yard to fill a function of improving value recovery and utilization that is not being realized for various reasons such as log supply and market conditions.

References:

1. Barbour, J.R. 1999. Relationship between diameter and gross product value for small trees. In: Proceedings from Wood Technology Clinic and Show Conference, Portland, OR. San Francisco, CA: Miller Freeman Publications.
2. Bilek, T. 2008. LSY: A spreadsheet tool to evaluate log sort yard economics (draft). Forest Products Laboratory, Madison, WI. 42p.
3. Dramm, J., R. Govett, T. Bilek, and G. Jackson. 2003. Log sort yard economics, planning, and feasibility. USDA Forest Service, Forest Products Laboratory, Madison, WI. FPL-GTR-146.
4. Dramm, J., G. Jackson, and J. Wong. 2002. Review of log sort yards. USDA Forest Service, Forest Products Laboratory, Madison, WI. FPL-GTR-132. 39p.
5. Howe, J. L. and S.M. Bratkovich. 1995. A planning guide for small and medium size wood products companies: the keys to success. USDA Forest Service, Northeastern Area State & Private Forestry. NA-TP-09-95. St. Paul, MN. 23p.
6. Safranski, S. R. and I.-W. Kwon. 1991. Strategic planning for the growing business. Small Business Administration. Emerging Business Series. EB-6. 25p.
7. Sedney, D. 1992. Simulation of a log merchandising and sorting yard. MS thesis. Univ. of Idaho. 103p.
8. Sessions, J., K. Boston, R. Hill, and R. Stewart. 2005. Log sorting location decisions under uncertainty. For. Prod. J. 55(12): 53-57p.
9. Sinclair, A. and G. Wellburn. 1984. A handbook for designing, building, and operating a log sort yard. Forest Engineering Research Institute of Canada (FERIC). Vancouver, B.C., Canada, 285p.

Proceedings of 2009 COFE: Environmentally Sound Forest Operations
32nd Annual Meeting of the Council on Forest Engineering
June 15-18, 2009
North Tahoe Conference Center, Kings Beach, California
Compiled by Bruce Hartsough and Bryce Stokes