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LSY: Documentation for a Spreadsheet Tool to Evaluate Log-Sort Yard Economics

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Abstract

A spreadsheet-based model, LSY (Log-sort Yard Cash Flow Analysis), has been constructed to aid in the pre-feasibility and financial feasibility analysis of log-sort yards. It is meant to be referred to concurrently with this documentation and is available for downloading at no cost from the Forest Products Laboratory's website at: http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr184/.

The model is flexible, allowing up to 20 species and grades that each may be sorted into up to 19 products, giving a total of 380 different output possibilities. The mix of those species and grades can be allowed to change over time. Sort-yard operating hours and productivity and number and type of employees can be changed over time. Cash flows reflect automatic replacement of capital equipment when it is projected to wear out. Data on various pieces of capital equipment and equipment configurations can be stored so that cost comparisons can easily be made between different sorting systems.

Keywords: Log-sort yard, financial feasibility, small-diameter, economics, break-even analysis, cost analysis, decision support

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Disclaimers

Please contact the author if you wish to use LSY for any purpose other than financial planning and cash-flow anaylsis of log-sort yard. Also, please contact the author if you have any questions or comments regarding its use. Neither Ted Bilek nor the U.S. Forest Service will accept any liability for losses resulting from reliance on the model's results.

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LSY: Documentation for a Spreadsheet Tool to Evaluate Log-Sort Yard Economics

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Introduction

This is the documentation for the spreadsheet model, Log-sort Yard Cash Flow Analysis (LSY). The model was designed to aid in financial planning and cash-flow analysis of log-sort yards.

Log-sort yards take in logs, possibly add some minimal processing, and then sort the logs into specialized grades more suitable for downstream processing. Sort yards work best when the incoming log mixes contain a wide variety of log sizes, grades, and possibly species. Also important is if markets are willing to pay a premium for logs that are more narrowly grouped. Where they succeed, log-sort yards are able to process and sort logs more cost-effectively than can be done at a forest landing or at a mill yard that is farther down the processing line.

Dramm and others (2004) examined the economics, planning, and feasibility of log-sort yards. In deciding to construct a sort yard, they recommended a step-by step progression through three main developmental stages involving (1) feasibility and business planning; (2) siting, layout, design, and construction; and (3) operations and business management. They provided a model, LOGYARDFEAS, that can assist in a pre-feasibility analysis.

LOGYARDFEAS provides a quick way to estimate gross margins on various species and log grades. Gross margin is the difference between the total cost associated with log purchase and sort yard operations and total revenue resulting from sorted log sales. If gross margin is negative or barely positive, there is little point in pursuing the project. If a strong positive gross margin is estimated, the project may be worth investigating further.

LOGYARDFEAS is relatively easy to use but is limited. Log-sorting costs are not itemized, but are instead entered as lump-sum numbers. A user would not be able to account for different equipment configurations or layouts. The log input mix over time cannot be changed; nor can changes in productivity. It is not possible to perform a detailed financial analysis using the LOGYARDFEAS because the program does not address cash flows and the time value of money over a number of years. LSY addresses these deficiencies.

LSY is an integrated financial model designed to cost out a log-sort yard over a 10-year planning period. Ten years was chosen as a period long enough to recover most capital investment required for a sort yard. Beyond this period, many critical input variables such as log supply, costs, and product prices become much more speculative.

LSY provides summary tables of 10-year cash flows, before tax and finance, before tax, and after tax. It also provides physical product flows over the project period. The model calculates net present values (NPV) and internal rates of return (IRR) both before and after taxes. LSY can be used to calculate the maximum amount that could be paid for logs while still providing the required rate of return.

LSY is spreadsheet-based, created in Microsoft Excel™ (Microsoft Corporation, Redmond, Washington), giving it a familiar interface, making it flexible, and providing it with all the built-in power of spreadsheet applications. The model is organized around worksheets that can be easily replaced or updated to effectively reflect the business environment for the sort yard operation. All data that must be manually entered are in blue. All inputs that are used by several worksheets are fully integrated so that they only need to be changed once to give new costings.

Net present values along with nominal and real internal rates of return are calculated before tax and finance, before tax, and after tax. A summary chart shows key cost areas. A cash-flow chart shows years in which there will be surpluses and deficits. Summary tables show which input species and grades as well as output products are most and least profitable. Key cost centers can be quickly identified. A full sensitivity analysis on revenues, nine cost centers, and a log-cost break-even analysis can be run from the summary page.

LSY has several inputs on its *Summary* worksheet, allowing you to easily see the effects of changed contingency assumptions or cost or revenue assumptions on the financial summary. Also included on the *Summary* worksheet are inputs that allow you to do a full sensitivity analysis without leaving this page.

Log-sort yard costs may be divided into two groups: current and capital costs. Log-sort yard costs are divided into current and capital costs, rather than variable and fixed costs, because of the effect of inflation on these expenses over time. Variable costs are always current costs. All current costs are subject to annual inflation. Whereas some fixed costs are current costs, other fixed costs are capital costs. For example, administration and insurance costs are

Limitations

Although LSY should be of use to anyone considering constructing a log-sort yard, using the model requires an understanding of cash-flow analysis. A fictitious example is provided to illustrate how the model functions and its results. The data do not represent a real-world example. Users will have to enter their own data appropriate for their specific circumstances. To acquire such data, users need to have a certain level of knowledge in forest operations, forest products marketing, and log procurement practices.

LSY has been extensively tested. However, the model is still released "as is." Users can view formulas and calculations. However, the model is not guaranteed to be free of errors under all calculation scenarios. The results of the model will only be as good as the input data. If the input data are poor, the results cannot be expected to be reliable. Even with good input data, all financial planning models involve forecasts. If conditions change to make the underlying assumptions invalid, this will invalidate the model's results. However, I hope that using LSY will provide improved information for decision-making in the set-up and operation of log-sort yards.

usually considered to be fixed costs, but they are charged and paid each year and would be expected to increase annually with inflation. In other words, administration and insurance costs, while fixed, are also current costs.

Other fixed costs (e.g., machinery, buildings) are capital costs. Most capital costs are depreciable (land is not). The annual expenses recognized for capital costs through depreciation do not increase annually with inflation. Depreciation expense is fixed when an asset is purchased and a depreciation method is chosen. The only time that depreciation expense is increased is when the capital asset is eventually replaced with a more expensive one.

In short, LSY assumes that all current costs increase with inflation. Depreciation expense for capital costs is fixed at the time the asset is purchased and depends on the asset cost and the depreciation method chosen.

Current costs are used within a year and therefore are allocated in the year in which they occur. With these, the effects of changing economic conditions or assumptions can be explored quickly and easily over the 10-year project planning period. Current costs include log input costs, wages, worker accessories, administration, and other costs. Current costs are relatively easy to calculate and allocate on the basis of standard rates and job estimates.

Capital costs involve investments whose use is spread over two or more years. Capital costs include land and buildings, chattels (e.g., office equipment), capital equipment, and working capital. Capital costs can be more difficult to allocate to a specific year. The difficulty is complicated further by the allowable depreciation expense.

Capital investments may wear out and need to be replaced at least once during the planning period. Alternatively, they may have an economic life longer than the 10-year planning period. In either case, they will probably have some terminal value at the end of the planning period.

To correctly calculate NPVs and IRRs and to correctly calculate break-even log costs and manufacturing costs, terminal values must be accounted for in the analysis. LSY does this automatically, basing the terminal values of capital assets either on the assets' estimated current values or their book values. Current values use straight-line depreciation based on the assets' economic lives, and increase resulting values for inflation. Book values use the assets' historic costs and whatever depreciation rate you have chosen.

A basic knowledge of discounted cash-flow analysis is required to understand the outputs provided by LSY, what they mean, and why they change when certain variables are altered. For background, see any basic corporate finance textbook (for instance, Brealey and Myers 1991 esp. Part 1: "Value."). Some understanding of accounting and depreciation is also helpful, but not essential to use this model. To enter data on appropriate equipment configurations for a log-sort yard, an understanding of forest engineering and sawmill operation is necessary.

To find out about LSY's features, structure, general assumptions, and limitations, continue reading. To see the inputs required to assemble a costing model, turn to Appendix 1. To see a printout of the title, contents, summary, and general assumptions worksheets in a sample run of the model, turn to Appendix 2.

LSY Features

Features in the log-sort yard model include the following:

- Up to 20 log input grades and 19 product output grades
- Up to eight different types of capital equipment
- Three depreciation methods or a user-specified custom rate
- Two methods for automatically calculating terminal values
- The option to purchase or lease land and buildings
- A library where common equipment types and equipment configurations may be stored
- Flexibility in shift scheduling and administration requirements
- Flexibility in log input and output mixes over time

- A comprehensive financial analysis showing 10-year cash flows and net present values and internal rates of return before tax and finance, before and after tax
- Extensive warnings and error messages indicating where the model might be producing misleading answers and when invalid information is entered

LSY Structure

The LSY model consists of 18 worksheets. They may be divided into seven groups (Appendix 2):

- Three preliminary worksheets (*Title, Introduction, Contents*), which have light green tabs
- One S*ummary* worksheet and two summary charts with yellow tabs
- One *General Assumptions* worksheet with a purple tab
- One *Gross Margin* worksheet with a green tab
- One *Consolidated Operating Costs* worksheet with a dark blue tab
- Eight subsidiary costs worksheets with light blue tabs
- One equipment library with a grey tab

The worksheets in each of these groupings are discussed below, followed by a brief discussion of the model's basic assumptions and limitations.

Preliminary Worksheets—Light Green Tabs

The three preliminary worksheets are the *Title*, *Introduction*, and *Contents.* The introduction contains some brief background to the model. The contents page describes the subsequent worksheets. These preliminary worksheets provide some guidance in using the model if this documentation is not open. In addition, comments in selected cells within the model provide additional information.

Summary Worksheets—Light Yellow Tabs

The three summary worksheets consist of a numerical *Summary* and two accompanying charts that consolidate the analysis results.

The *Summary* is the bottom line, containing the final costings, financial indicators, and 10-year cash flows. It also contains the input variables to conduct a sensitivity analysis. Tables on this worksheet include financial indicators; the revenue and cost summary; the break-even summary; sensitivity analysis scaling factors; and a cash-flow summary.

On the *Summary* worksheet, the Financial Indicators (Screenshot 1) include net present values (NPV) and internal rates of return (IRR). Net present value is the difference between a project's positive cash flows and its negative cash flows discounted back to the present (i.e., adjusted for interest) at the weighted average cost of capital (WACC is an interest rate, also known as the discount rate). If a project's NPV is positive, it is earning a rate of return higher than the discount rate used to calculate the NPV. If a project's NPV is negative, it is earning a rate of return lower than the discount rate used to calculate the NPV.

Other literature may refer to the NPV calculation as net present worth (NPW) or present net worth (PNW). All refer to the difference between a project's benefits and its costs when both are discounted at an appropriate rate.

Internal rate of return is an interest rate at which NPV = $0. The IRRs are shown both as nominal percentages, including inflation, and real percentages, not including inflation. Because NPV is identical in either real or inflation-adjusted terms, only one set of NPV figures is shown. Both NPVs and IRRs are shown before tax and finance, before tax, and after tax.

Before-tax NPV is calculated using before-tax cash flows and by using a tax-adjusted after-tax WACC for the discount rate. The formula to calculate this before-tax WACC follows:

Before-tax WACC = After-tax WACC / (1 – Tax rate)

The Financial Indicators table also contains a number, IRR Test, shown in blue. All user-input variables in LSY are in blue. The IRR Test is a beginning point for the computer's internal rate of return calculation. A normal default would be 10%. However, if the IRR is undefined or if the cash flows in the Summary table that follows are negative at some other time than at the start, it is advisable to do some tests with some extreme values, both positive and negative, to test for extremely high or low IRRs or for multiple IRRs.

FINANCIAL INDICATORS	Net present value	Nominal IRR	Real IRR
Before finance & tax	$ 1,545,605	21.6%	18.1%
Before tax	$ 1,728,811	28.3%	24.6%
After tax	$ 808,482	14.3%	10.9%
		IRR Test =	10%

Screenshot 1—LSY's financial indicators on the *Summary* worksheet

REVENUE & COST SUMMARY	After-tax PV	$/Piece (input)	$/MBF (input)	$/MBF (output)	Pct. of sales
Gross revenue					
Sales revenue	$ 73,211,307	13.51	340.36	358.27	100.0%
Log costs	(47,752,761)	(8.81)	(222.00)	(233.68)	-65.2%
Subtotal: gross margin	$ 25,458,546	$ 4.70	$ 118.36	$ 124.58	34.8%
Operating costs					
Capital costs	$ (5,396,295)	(1.00)	(25.09)	(26.41)	-7.4%
Direct production costs	(11,162,706)	(2.06)	(51.89)	(54.63)	-15.2%
Fixed costs and overheads	(5,914,096)	(1.09)	(27.49)	(28.94)	-8.1%
Working capital	(270,553)	(0.05)	(1.26)	(1.32)	-0.4%
Subtotal: operating costs	$ (22,743,650)	$ (4.20)	$ (105.73)	$ (111.30)	-31.1%
Financing and taxes					
Financing	(81,138)	(0.01)	(0.38)	(0.40)	-0.1%
Capital gains and income taxes	(1,825,276)	(0.34)	(8.49)	(8.93)	-2.5%
Subtotal: financing and taxes	$ (1,906,414)	$ (0.35)	$ (8.86)	$ (9.33)	-2.6%
Net profit	**$ 808,482**	**$ 0.15**	**$ 3.76**	**$ 3.96**	**1.1%**

Screenshot 2—LSY's revenue and cost summary on the *Summary* worksheet

BREAK-EVEN AND PROFIT SUMMARIES	Year 0 value	Year 1 value
Optional summary log input cost ($/MBF input)	$ 228.26	$ 235.10
Calculated avg. break-even log cost ($/MBF input)	$ 228.22	$ 235.07
Actual weighted-avg. log input cost ($/MBF input)	222.00	228.66
Estimated pre-tax net profit ($/MBF input)	$ 6.22	$ 6.41
Actual weighted-avg. product value ($/MBF output)	$ 358.27	$ 369.02
Calculated avg. break-even product value ($/MBF output)	351.72	362.27
Estimated pre-tax net profit ($/MBF output)	$ 6.55	$ 6.75
Calculated avg. break-even log cost ($/piece input)	$ 9.06	$ 9.33
Actual weighted-avg. log cost ($/piece input)	8.81	9.08
Estimated pre-tax net profit ($/piece input)	$ 0.25	$ 0.26

Screenshot 3—LSY's breakeven and profit (loss) summaries on the *Summary* worksheet

The Revenue & Cost Summary (Screenshot 2) contains present values of the revenue and all the major cost categories. These present values are provided in terms of total dollars, and dollars per unit. All the costs are also given as a percentage of sales so that you may see which of the cost categories are the most significant. See the far right column of Screenshot 2. This is one type of sensitivity analysis.

The net profit (loss) calculated in Revenue & Cost Summary is a net present value. That is, it represents after-tax profit (loss) over and above the owners' after-tax weighted average cost of capital. The net profit (or loss) in Revenue & Cost Summary above is identical to the after-tax net present value in the Financial Indicators in Screenshot 1. If the net profit (loss) = $0, then the internal rate of return will be equal to the after-tax real weighted average cost of capital.

The Break-even and Profit (Loss) Summaries (Screenshot 3) contain calculated break-even log costs on a volume and per-piece basis. These represent the maximum average amount at the project's start-up that could be paid for input logs and pay for sorting costs, while still providing the specified after-tax return on capital. The break-even product value is a minimum price at which the yard's logs must be sold in order to provide the specified after-tax rate of return. The estimated profit (or loss) shows the yards estimated pre-tax margin (or loss).

The Break-Even Cost Calculation and Working Capital

The break-even log cost calculation may only be an approximation because of a circular relationship (Fig. 1). Inventory value and accounts payable are in part a function of log cost. For example, if log costs increase, the value of logs held in inventory will also increase, as will the value of accounts payable. Inventory value and accounts payable are also components of working capital, one of the costs that must be recovered in order to break even.

Following the relationships in Figure 1, as log costs change, inventory value and accounts payable both change. As inventory value and accounts payable change, working capital requirements change. As working capital requirements change, the break-even log cost changes. As the break-even log cost changes, inventory value and accounts payable both change.

If inventory and accounts payable are major components of working capital, and if working capital is a major cost component, and if the net profit (loss) is far different from $0, then calculated break-even log cost and the true break-even log cost will be significantly different. If working capital is only a minor component of total costs, the calculated break-even log cost will be very close to the true break-even cost. It may differ by only a few cents. The only way to calculate the true break-even log cost is to either use Excel's Goal Seek function or do successive iterative calculations until the net profit (or loss) in the Revenue & Cost Summary table is $0.

The Break-even and Profit Summaries also provide an optional input for log costs, shown in blue. If the log costs on the *Gross Margin* worksheet (cells C104:C123) are set equal to this optional log input cost, the true break-even log input cost may be found on the *Summary* worksheet by successive iteration or by using the built-in Excel function, "Goal Seek." In either case, the objective is to find the log input cost so that the net profit (or loss), in cell B32 on the *Summary* worksheet, is $0. At this point, the IRR will be equal to the after-tax weighted average cost of capital.

IMPORTANT! These break-evens are in terms of Year 0 values. If these values are being used to set contract prices for the upcoming years, then they should be adjusted for inflation. That is why the Year 1 values are shown in the Break-Even and Profit Summaries table on the *Summary* worksheet (Screenshot 3).

The *Summary* worksheet contains input options for running a sensitivity analysis. The Sensitivity Analysis Scaling Factors (Screenshot 4) can be varied above and below 100% to see the effect of changes in costs or revenues on the net present values, internal rates of return, and cash flows. The sensitivity analysis scaling factors for sales revenues and log costs are incorporated into the analysis on the *Gross Margin* worksheet. All other scaling factors are incorporated on their individual costing worksheets.

Calculating the Full Break-Even Manufacturing Cost

The full break-even manufacturing cost is the cost that would have to be charged in Year 1 just to process the logs (for example, if the logs were taken on consignment). The break-even manufacturing cost does not include any log input costs. Implicit in this calculation is the assumption that the manufacturing cost will increase annually with inflation.

To find the full break-even manufacturing costs ($/MBF input), including fixed costs, overheads, and the required after tax return on invested capital, set the sensitivity analysis scaling factor for sales revenues to 0% (cell J14 on the *Summary* worksheet). The effect of this is to zero out all log sales revenue. Now the break-even log cost will equal the full manufacturing costs.

To calculate the break-even log cost, set all the log input costs on the *Gross Margin* worksheet (cells C104:C123 on the *Gross Margin* worksheet) all equal to the Optional log input cost in the Break-Even and Profits Summaries table (cell B37 on the *Summary* worksheet), and force the net profit or loss in the Revenue & Cost Summary table (cell B32 on the *Summary* worksheet) to $0 by changing the Optional log input cost (cell B37 on the *Summary* worksheet) either iteratively or using Excel's Goal Seek function.

The optional break-even log input cost will then represent the full break-even manufacturing costs, including the required return on capital. Note that this cost will be negative. All product sales revenue is eliminated (by setting the sales revenue sensitivity factor equal to zero); therefore, the only way to recover manufacturing costs is through negative log costs. These negative log costs would represent tipping fees that at the break-even point with no other sales revenue would exactly equal the manufacturing costs.

Related to the sensitivity analysis scaling factors are Cost Contingency Allowances. These allow you to provide an extra percentage over and above the given costs as an overrun allowance without having to adjust the sensitivity analysis scaling factors. The Cost Contingency Allowances are incorporated into the analysis on the *Consolidated Operating Costs* worksheet.

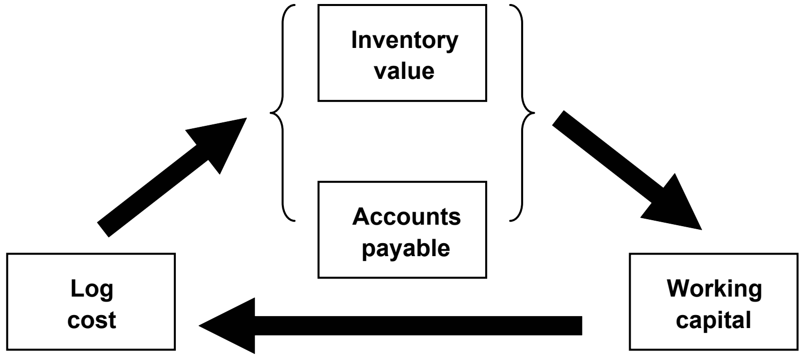

Figure 1—The circular relationship between log cost and working capital.

SENSITIVITY ANALYSIS SCALING FACTORS		
	Sales revenues	100.0%
	Log costs	100.0%
	Land & bldg.	100.0%
	Chattels	100.0%
	Capital equipment	100.0%
	Wages	100.0%
	Crew accessories	100.0%
	Administration	100.0%
	Other costs	100.0%
	Working capital	100.0%

Screenshot 4—LSY's sensitivity analysis scaling factors on the *Summary* worksheet

The Cash Flow Summary is a combined 10-year projection of capital costs, revenues, and annual expenses. A Bottom Line Summary shows the cash flows before tax and finance, before tax, and after tax at the top of the worksheet. The main assumptions on this model are the following:

- All cash flows occur at the end of each year.
- Year 0 represents the start of the project's operations.
- All cash expenses and revenues will increase at the specified inflation rate.
- Depreciation expense will not increase with inflation.
- As chattels and capital equipment wear out, they will be replaced with identical units that will have increased in cost according to the specified inflation rate.
- If the taxable cash flow is negative in any given year, the owners have sufficient income from other sources so they can take a tax deduction in that year and not have to carry the tax credit forward, which would reduce the owners' total rate of return.

The Pre-tax Profitability and Break-even Log Cost Estimate table summarizes the break-even manufacturing costs and calculates the maximum amount that could be paid for logs and still break even, returning just the required after-tax rate on invested capital. After actual log costs are deducted, the remaining profit (or loss) is an estimate of the additional amount available (or required) on a pre-tax basis that would still provide the required rate of return.

Additional tables on the *Summary* worksheet include the Volume Processed Summary, the Annual Productivity Summary, and a Summary Cash Flow table.

Two charts provide a quick view of the project's cost breakdowns, potential profitability, and cash flows. The *Pie Chart* shows a consolidated picture of the Revenue & Cost Summary table from the *Summary* worksheet (Fig. 2). All the figures are shown on an after-income tax basis. The groupings follow:

- Log costs
- Capital costs
- Other operating costs
- Financing and taxes
- Net profit (loss)

Note that profit is defined as any return over and above the owners' required return on invested capital. Loss is a smaller-than-required return on invested capital.

The *Cash Flow Chart* shows the cash flows over the project's life on three bases: before tax and finance, before tax, and after tax. A sample of the cash-flow chart is shown in Figure 3.

General Assumptions Worksheet—Purple Tab

General assumptions are common assumptions among several of the worksheets. Some of these assumptions must be entered. Some are calculated based on the entered assumptions. Both are shown on the *General Assumptions* worksheet.

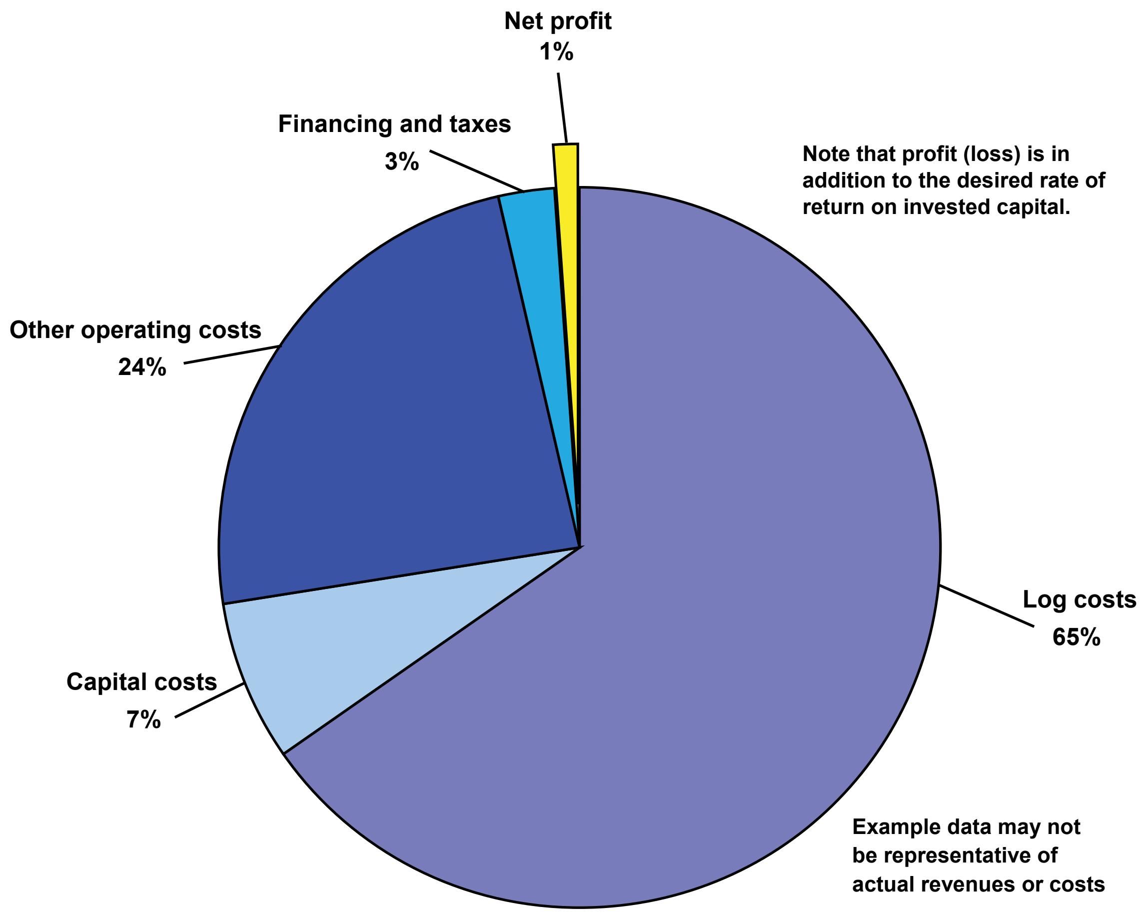

Figure 2—Log-sort yard discounted after-tax costs and net profit (loss) as a portion of sales revenue.

Although the general inputs must be individually entered, it is possible that they could be set as a function of another worksheet. For example, if data are available from a survey of fuel prices, the fuel price on the *General Assumptions* worksheet could be set equal to an average quote or to the lowest quote available.

The *General Assumptions* worksheet is divided into five major sections: entered general assumptions; calculated weighted average cost of capital (WACC); system capacity; resource supply; and a piece count and volume count calculator.

Entered General Assumptions

The entered general assumptions include interest rates, other general assumptions, and income and capital gains taxes. The interest rates, the rates the bank charges for borrowing and lending, the inflation rate, and other factors are used to determine the weighted average cost of capital and the interest paid on loans. The time to start up applies to the land and buildings. The *Ad valorem* (property) taxes apply to the land and buildings, chattels, and capital equipment.

Calculated Weighted Average Cost of Capital

The WACC depends on the required rate of return on equity and debt, and the percentages of equity and debt in the capital structure. The required rate of return on equity is equal to the bank deposit rate plus a user-entered risk premium, which is added to the deposit rate. The return on debt is the bank's interest rate that is charged on borrowed capital.

The WACC is first calculated in nominal terms, which includes inflation. With inflation taken out, the WACC is in "real" terms. The WACC is also calculated before income taxes and after a combined income tax rate is deducted. The formulas used to calculate the WACC follow:

Before-tax nominal WACC is the before-tax nominal weighted average cost of capital. This is the before-tax rate

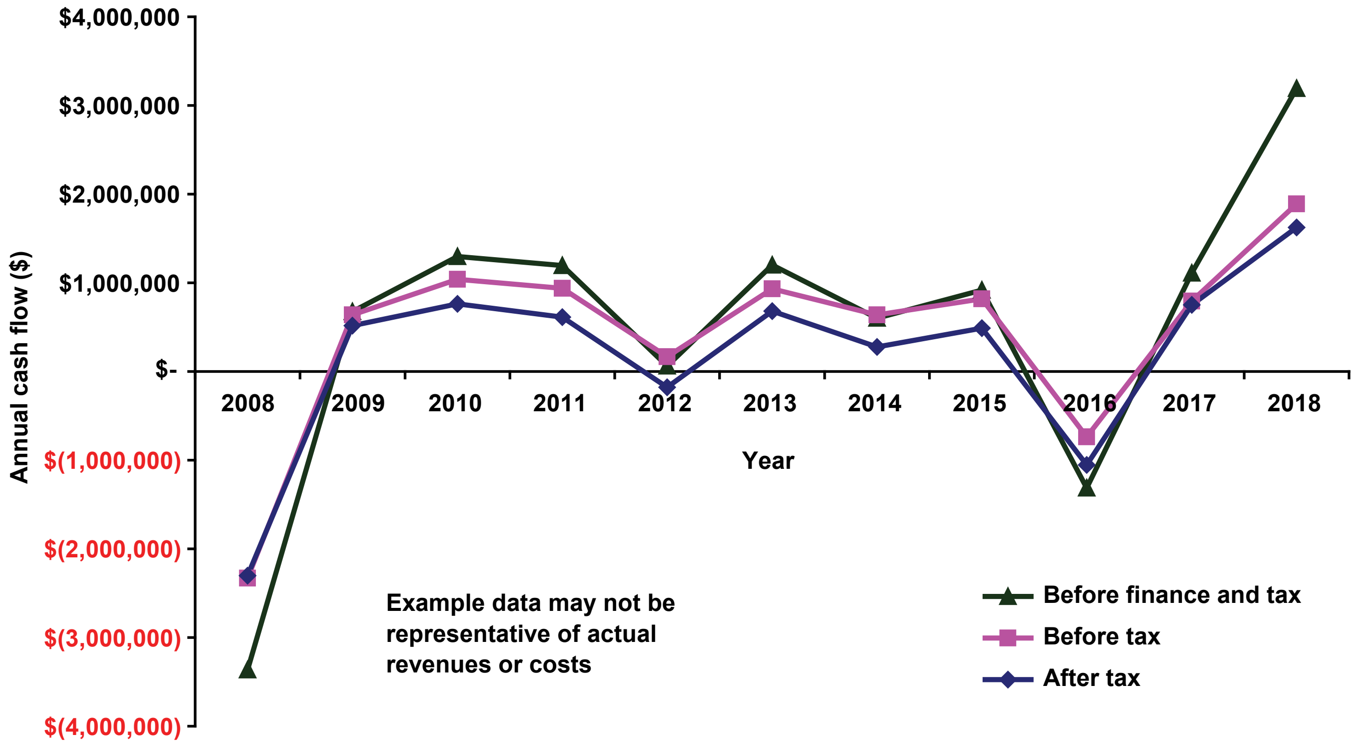

Figure 3–Log-sort yard annual cash flows.

of return including inflation that the owners would expect to earn on all before-tax cash flows. The following formula is used:

$$\text{Before-tax\_nominal\_WACC} = [(\text{Bank\_deposit\_rate} + \text{Return\_on\_risk\_capital}) \times \text{Equity/Total\_capital}] + (\text{Bank\_lending\_rate} \times \text{Debt/Total\_capital})$$

where Debt/Total capital is the percentage of each piece of capital equipment that is financed with debt**.** This percentage is entered on the *Summary* worksheet. **Note that this ratio decreases over time as debt is paid off.** When new equipment is purchased, the ratio increases again. With the Debt/Total capital known, the Equity/Total capital is calculated using the following formula:

$$\text{Equity/Total\_capital} = 1 - \text{Debt/Total\_capital}$$

Before-tax real WACC is the before-tax real weighted average cost of capital. This is the before-tax rate of return after inflation that the owners would expect to earn on before tax and finance cash flows. To adjust for inflation, the following formula is used:

$$\text{Before-tax\_real\_WACC} = \frac{(1 + \text{Before} - \text{tax\_nominal\_WACC})}{(1 + \text{Inflation\_rate})} - 1$$

After-tax nominal WACC is the after-tax nominal weighted average cost of capital. This is the after-tax rate of return including inflation that the owners would expect to earn on after-tax cash flows. The following formula is used:

$$\text{After-tax nominal WACC} = \text{Before-tax nominal WACC} \times (1 - \text{Combined\_tax\_rate})$$

where the Combined_tax_rate recognizes that state income taxes are deductible from federal income taxes and is calculated using the formula:

$$\text{Combined\_tax\_rate} = (\text{Federal\_income\_tax\_rate} + \text{State\_income\_tax\_rate}) - (\text{Federal\_income\_tax\_rate} \times \text{State\_income\_tax\_rate})$$

After-tax real WACC is the after-tax real weighted average cost of capital. This is the after-tax rate of return after inflation and taxes that the owners would expect to earn on capital investment. To adjust for inflation, the following formula is used:

$$\text{After-tax\_real\_WACC} = \frac{(1 + \text{After-tax\_nominal\_WACC})}{(1 + \text{Inflation\_rate})} - 1$$

System Capacity and Resource Supply

LSY's basic unit of capacity is the operating shift (one shift per day). Assumed output is stated in terms of production per shift. Labor requirements and capital equipment operation are input on a per-shift basis. The maximum number of shifts per year will depend on the number of days that can be worked for each shift. Labor costs will depend on the number of workers required, the hours per shift, and the number of operating days per year for each shift.

The volume of logs processed depends on shift capacity, the facility full-time operation, the percentage of full-time operation, and how efficiently it is used. Shift capacity depends on the machine configuration used and is manually entered on the *Capital Equipment* worksheet.

The percent of full-time operation allows for an operation to not use its full-time capability. This might happen if the start-up process is slower, perhaps as resource supplies dictate (for instance, workers are hired for a full shift, but do not actually process a full shift's worth of logs), or as labor is gradually trained for the operation. The percent of total operating capacity used may represent operational inefficiency and delays. As workers gain more experience operating the equipment, they may be expected to become more efficient and the percentage of total operating capacity used may increase.

Knowing the log distribution is critical. Resource supply will affect the system throughput volume. Throughput volume directly affects revenue. Volume and both piece size and revenue are usually positively correlated. However, the number of pieces per hour that any given sorting system can handle highly depends on log sizes and processing requirements. In general, smaller logs mean more logs per thousand board feet (MBF), which translates to fewer MBF per hour and lower revenue and higher per-unit processing costs.

Either volume or number of pieces may limit system throughput. If a large portion of the logs handled by a yard are larger diameter, then there will probably be a total volume limit on the yard's throughput. If a large portion of the logs handled by a yard are small diameter, then the throughput limit will probably be related to the number of pieces that the equipment can handle.

The log-size distribution over time by either pieces or volume is entered in this section. The total number of pieces processed and the total volume processed are then calculated.

To aid in the piece and volume calculations, piece- and volume-count calculators are provided at the bottom of this worksheet. In the piece-count calculator, given the total volume and the volume distribution, the number of pieces and piece distribution are calculated. In the volume calculator, given the piece count and the piece-count distribution, total volume and volume distribution are calculated. These calculators are optional: numbers calculated in the piece and volume count calculators are not used directly in any other tables, although they may be copied and pasted in the Piece Size Distribution or the Volume Distribution table.

Note that the log distribution entered in the Resource Supply table on the *General Assumptions* worksheet only affects the system materials handling capacity and throughput. The distribution is not integrated with either the log input mix percentages or with the product recovery percentages on the *Gross Margin* worksheet.

Gross Margin Worksheet—Green Tab

Gross margin = Value of product sales – Log costs

Value of product sales = Σ(Units sold × Price/unit)

Log costs entered in LSY are assumed to be delivered costs at the log-sort yard gate. They would incorporate all costs required to deliver the logs to that point, including felling, delimbing, and bucking, skidding, loading, pre-sorting, and transport.

Gross margin is defined this way because log costs are such a significant portion of a sort yard's total costs. If the yard cannot cover the basic raw materials costs, then there is no point in operating. The gross margin is what is left over to pay for manufacturing costs and overheads after the basic raw materials costs have been covered.

At the top of the *Gross Margin* worksheet, the Summary Gross Margin Present Values (Screenshot 5) shows the total gross margin in total, per piece, per thousand board feet of log inputs, and per thousand board feet of log outputs. Log costs and gross margin are also shown as a percentage of sales.

A number of inputs are required on the *Gross Margin* worksheet: product output prices; log costs; input log mix percentages over time; and product recovery percentages.

All input data on this sheet are required by log input grade. Note: there is no quantified relationship in the model between the piece size distribution or volume distributions

SUMMARY PRE-TAX GROSS MARGIN PRESENT VALUES

	Total	$/Piece	$/MBF input	$/MBF output	Pct. of sales
Present value of product sales	$ 73,211,307	$ 13.51	$ 340.36	$ 358.27	100.0%
Present value of log costs	(47,752,761)	(8.81)	(222.00)	(233.68)	-65.2%
Present value of gross margin	$ 25,458,546	$ 4.70	$ 118.36	$ 124.58	34.8%

Screenshot 5—LSY's summary gross margin present values

input in the *General Assumptions* worksheet and the log input grades in the *Gross Margin* worksheet. They are independent inputs.

It is possible that there is just one input log grade: mixed-grade, mixed-species unsorted logs. If all input logs are the same grade and species, or you have no knowledge about the differences in outputs that could be produced from the input logs, use just input one grade.

Alternatively, log input grades may be divided by whatever is logical for the sort yard. This may be price, if different log types have different prices. Or the input grades may be based on species and log quality (e.g., species, size, branch size, sweep, origin). This would make sense if different log input types produce different outputs. The only limitations are that you can provide no more than 20 log input grades, and product recoveries must be provided for each input log grade. If several product possibilities are possible from any given input grade, the logs should be allocated to the highest value uses. For example, although a veneer-grade log could be pulped, it should be allocated to veneer. Note that LSY does not allocate logs to various product classes, depending on market demands and product prices.

A built-in assumption is that the product recoveries for a given log input grade do not change over time. However, altering the percentages processed in those log input grades by year may change the quantity of logs actually processed in a given grade over time.

Product outputs are generally by use class (veneer peeler, premium sawlog, stud bolts, pulpwood). Some may be broken down further into quality grades such as in hardwood factory logs. LSY is limited to 19 log output grades, including unmerchantable residue; however, when combined with the 20 possible species and grades, this leaves possibilities for 380 (= 19 × 20) possible different product prices.

Other inputs required on the *Gross Margin* worksheet include the following:

- **Product output prices and log costs** are both expressed in Year 0 dollars; that is, prices and costs at the yard's start-up phase. The program assumes that these prices and costs will increase by whatever inflation rate is specified. The Log Costs Input table allows for a production volume loss by log input grade. This volume loss may be due to damage, drying, degrading, manufacturing waste, etc. The total volume produced from each log input grade will be reduced by this percentage.
- **Log input mix percentages** show the allocation of the log input mix over time. If the input percentages in any given year produce a sum less than 100%, a warning will appear. If they sum to greater than 100%, an error message will appear.
- **Product recovery percentages** allocate the products that can be produced from each log input grade. Any percentages not assigned to individual products by default go to unmerchantable residue.

Following the input data are some calculated tables used in the Consolidated Cash-Flow table. Additional tables may provide useful management information. The calculated tables follow:

- **Gross margin by log input grade ($)**
  The last column in this table is the Percent of total gross margin, which shows log input grades that contribute most to the gross margin. Also, if any log grades produce negative gross margins, these grades and the cash flows will appear in red. These are important because the product revenues from these unprofitable grades do not even cover the log costs.
- **Gross margin by log product name ($)**
  Note that the last column in this table is the Percent of total gross margin, which shows the log products that contribute most to the gross margin. Also, if any log products produce negative gross margins, these products and the cash flows will appear in red. These are important because the revenues from these unprofitable products do not even cover the log costs.
- **Unit gross margin by log product name ($/MBF output)**
  Note that if there is a negative unit gross margin on any product in any year, both the negative margin and the product name will appear in red.
- **Unit gross margin by log input grade ($/MBF output)**
  If a negative unit gross margin is on any log input grade in any year, both the negative margin and the log input grade name will appear in red.
- **Sales revenue divided by log input grade ($)**
  The last column in this table is the Percent of total discounted sales revenue, which shows the log input grades that contribute most to total sales revenue.
- **Sales revenue divided by log product name ($)**
  The last column in this table is Percent of total discounted sales revenue, which shows log products that contribute most to total sales revenue.
- **Log cost by log input grade ($)**
  The last column in this table is Percent of total discounted sales revenue, which shows log input grades that account for the greatest portion of total cost of goods sold.
  - Log cost by log product name ($)
  - Unit log cost by log input grade ($/MBF)
  - Gross log input volume by log input grade (MBF)
  - Net log production by log input grade (gross input less production volume loss) (MBF)

- Net log production by log product name (gross input volume less production volume loss) (MBF)
- Year 1 gross margin summary by log input grade and log product name ($)
- Year 1 sales revenue by log input grade and log product name ($)
- Year 1 log cost summary by log input grade and log product name ($)
- Year 1 product volume produced by log input grade

Costing Worksheets—Blue Tabs

Nine worksheets cost out various parts of the log-sort yard operation. They consist of a *Consolidated Operating Costs* worksheet (dark blue tab) and eight subsidiary worksheets (light blue tabs). The costing worksheets draw on common inputs from the *General Assumptions* worksheet. Individual cost items also are entered on some of the subsidiary worksheets. Outputs from the *Consolidated Operating Costs* worksheet are exported into the *Summary* worksheet.

Consolidated Operating Costs Worksheet—Dark Blue Tab

The *Consolidated Operating Costs* worksheet summarizes the operating costs. It consolidates information from the eight individual subsidiary costing worksheets that provide detailed costs for the various components of the log-sort yard operation. The *Consolidated Operating Costs* worksheet contains all costs apart from the log costs, which appear on the *Gross Margin* worksheet. The *Consolidated Operating Costs* worksheet includes direct operating costs, financing, adjustments, and working capital.

On the *Consolidated Operating Costs* worksheet, the present value of the operating costs is calculated on an after tax and a before tax basis. This latter amount is used in a break-even log cost calculation on the *Summary* worksheet and is the minimum that must be recovered over the project's life to return the non-log variable and fixed costs and the required rate of return. Log input costs are included on the *Gross margin* worksheet.

The *Consolidated Operating Costs* worksheet contains a Bottom Line Book Value Summary table for assets and loans, with net asset value calculations that may be useful for management purposes. Any contingency allowances from the *Summary* worksheet are incorporated into the analysis on the *Consolidated Operating Costs* worksheet. Other major assumptions are also shown, along with a cash-flow table that consolidates all the operating costs from the eight subsidiary costing worksheets:

- *Land&Bldg*
- *Capital Equipment*
- *Chattels*
- *Wage*
- *Crew Accessories*
- *Admin.*
- *Other Costs*
- *Working Capital*

Land&Bldg. Worksheet—Light Blue Tab

Land&Bldg. accounts for the costs with land and buildings. Land costs include both land and depreciable land improvements. However, land itself may not be depreciated. Buildings do not include chattels, which are accounted for on another worksheet.

Land and buildings may be purchased or leased. If land or buildings are leased, then the lease cost is deductible from the taxable income in the year it occurs and there is no allowable depreciation. If they are purchased, then the interest component of any financing is deductible in addition to depreciation on the buildings and depreciable land improvements.

A difference between chattels and real estate is that whereas chattels usually decline in value over time, real estate usually holds and may increase its value. In terms of cash flows, this only matters at the end of the project. The real assets' terminal values must be accounted for using either Book or Then-current values. Book is the historic cost, less the IRS-allowed depreciation. Note that for land there is no IRS-allowed depreciation.

Then-current may be a better approximation of the actual value that is received. The calculation takes the historic cost, plus inflation, and for buildings deducts an allowance for decline in value due to age. However, unless these terminal values are a significant portion of the total project cash flows, the terminal value estimate used will not have much effect on overall analysis results.

Chattels Worksheet

Chattels are movable resources or property rights other than freehold land, such as computers, office equipment, and tools. The *Chattels* worksheet calculates cash flows for depreciable building contents, weigh scales, and sorting bunks. Chattels could also apply to capital equipment, inventory, and loose tools. However, these assets are accounted for elsewhere.

The *Chattels* worksheet is constructed so that as assets reach the end of their economic lives, they are automatically replaced at their original cost, plus inflation. Terminal values are based on assets' book values.

Some of the inputs for this worksheet come from the *General Assumptions* worksheet. Some are provided on the worksheet.

Capital Equipment Worksheet

The *Capital Equipment* worksheet calculates a 10-year cash-flow statement for capital and operating costs associated with up to eight different types of capital equipment. The capital equipment cost calculations are a simplified version of the methodology presented by Bilek (2007).

Calculations depend on inputs, some of which are imported from the *General Assumptions* worksheet. Others that apply to only these costings are entered on this worksheet under Capital Equipment Costing Assumptions.

Among the inputs is one for economic life, which is the actual estimated operating life. As this number is varied, the Cash-Flow table is automatically adjusted as the equipment replacement years change. Operating life is also related to repairs and maintenance. As the number of operating hours per year increases beyond standard expected hours, repairs and maintenance also increase. The implicit assumption is that repairs and maintenance will increase in a linear fashion as operating hours increase beyond the standard. This is accounted for in the Repairs & Maintenance Scaling Factor table.

The economic life also affects equipment current values. Current value is beginning current, less current depreciation, plus inflationary gains. Current depreciation is a straight-line rate over the asset's economic life.

Summary Cash Flows for Equipment

Summary Cash Flows for Equipment provide 10-year cash-flow summaries of capital costs, revenues, and expenses. As with the combined cash-flow summary, Bottom Line Summary is at the top of this page. This is to consolidate the individual machine costs and provide management cost summaries. Following the Summary Cash Flows are more detailed cash flows. Below the more detailed cash flows are calculations for individual line items, where needed, to make these calculations more explicit. Individual calculations are included for the following:

- Replacement
- Salvage
- Repairs and maintenance
- Fuel consumption
- Fuel cost
- Oil & lube cost
- Depreciation expense
- Accumulated depreciation
- Tax gain (loss) on salvage
- Book value calculations
- Current value calculations
- *Ad valorem* (property tax) calculations
- Loan principal
- Bank finance charges
- Loan principal repayments
- Loan balance calculations
- Loan interest payments

Equipment Cash-Flow Models

Equipment cash-flow models are provided for each of eight types of capital equipment. Each equipment model follows an identical format, showing summary financial measures, other financial information, and a Detailed Cash-Flow table for specified equipment over the equipment's expected useful life.

Summary Financial Measures

NPV is the investment's net present value, although in this case the term is somewhat of a misnomer. Here, NPV represents equipment cost only. It is the sum of discounted cash outflows and is the cost today of owning and operating the equipment over its economic life.

Before tax & Finance is the return based on only the cash flows of the investment without taking into account taxes or financing. This is the conventional measure for evaluating investments. In theory, the investment decision should be separate from the finance decision. The rate of return before tax and finance does not change with different tax rates or finance options.

Before tax return includes the cash flows resulting from the investment's financing. If the before-tax rate of return is greater than the before tax and finance rate of return, then there is a favourable gearing effect. In other words, financing the equipment with loan money is advantageous to the investor. This statement assumes that capital equipment is the investor's major investment, that this loan rate represents the investor's average cost of borrowed capital, and that this borrowing will not affect the investor's ability to borrow for other worthy investments.

After tax return includes all cash flows associated with the investment and financing chosen. It assumes that if the investment suffers a tax loss in any given year, income will be available from other sources against which the loss may be deducted.

Other Financial Information

Annual loan payment: the total payment (principal + interest) required over the loan term. The loan term is the shorter of either GDS (General Depreciation Schedule) or economic life.

Cash-Flow Table

The Cash-Flow table shows cash flows for a single piece of equipment over its expected life. Replacement costs are not calculated here. Built into this Cash-Flow table is the assumption that all cash costs and all revenues will increase at the specified inflation rate. Depreciation expense is the only item not affected by inflation. Depreciation expense is fixed at the time the asset is purchased and the depreciation schedule is chosen.

Wages Worksheet

The *Wages* worksheet does costing calculations for hourly wageworkers only. Management and supervision is accounted for on the *Admin* worksheet. *Wages* uses inputs from the *General Assumptions* worksheet, as well as some inputs that are entered on this worksheet in order to calculate wages cash flows for hourly wageworkers.

Important! Salaried employees should NOT be included as one of the crew when working out the wages expense. Salaried employees are included in the *Admin* worksheet.

The *Wages* worksheet is divided into three major sections: Summary Tables, Assumptions, and Calculations.

The Summary Tables portion of the *Wages* worksheet has wages and productivity. Wages Summary tables are by worker type (scalers, graders, etc.) and by wage type (hourly, overtime, and fixed costs). Both totals should be identical. The Productivity Summary shows pieces and MBF per hour, per shift, and per year.

The Assumptions portion of the *Wages* worksheet is divided into four sections: Employees required and hired; Standard and available work hours; Base hourly wage rates plus allowances by worker type; and Individual worker accessories.

Hourly employees required is the number of employees by worker type that are required for each shift. You should fill in this table even if you plan to run just one shift. This will prevent later errors if any "what if" scenarios are run with the shifts. The number of shifts that are actually worked is entered on the *General Assumptions* worksheet in the Facility Full-Time Operation Shift Hours table.

Hourly employees hired is the number of employees actually hired by employee type over the years. If any over-worked errors appear, it means that for at least one year and one employee type, not enough hours are available to meet the shift requirements. This means that either shift requirements have to be decreased, the number of available hours has to be increased in the Standard and Available Overtime Hours/Worker input table, or the number of employees hired in at least one year needs to be increased. The years in which there are problems will appear highlighted. They are also shown farther down by worker type in the Wages and Hours Calculation by Worker Type tables.

Minimizing Hourly Wages Costs

Depending on fixed costs/worker and extra premium paid for overtime hours, you may possibly reduce total wages by hiring more workers. It is possible to determine the number of workers that will minimize hourly wages costs either by trial and error, or by using Excel's built-in "Solver" package, a linear programming model. Linear programming is a technique to maximize or minimize a specified goal subject to certain constraints.

To minimize total wages costs, first make sure that Solver is installed. To do this go to Excel's "Tools-Add ins." Next, have Solver minimize the negative sum of total employment costs while allowing the number of employees hired each year to vary. Constraints would be that total remaining available hours for each employee group for each year must be greater than or equal to zero, the number of employees hired each year in each group must be greater than or equal to zero, and the number of employees hired each year should be an integer.

If production is going to be changing over time, it is better to do this optimization a number of times and year by year. If production is not going to be changing, a faster and more accurate solution may be achieved by just allowing the number of employees over the first year or two to change. Realistically, only employment over the first few years will be of concern. After that, economic and operating circumstances may have changed and you will need to re-analyze the operation.

The Standard Work Hours and Available Overtime Hours Wages worksheet, (rows 85–96) shows the number of hours for which a worker will be paid ordinary hourly rates and the number of available hours for overtime work.

- **Standard work hours per worker** is calculated on a template that incorporates weekends and holidays. Vacation days and allowable sick days are also included. The standard hours/shift is imported from the *General Assumptions* worksheet. Implicit in the calculations is the assumption that if a worker is required to work more hours than the equivalent of one shift, then the worker will be working overtime.
- **Available overtime hours per worker** is the number of hours per year available for overtime. Standard shift hours plus available overtime hours is the maximum number of available work hours. If this total is exceeded by any worker type, then a warning will appear in the Employees Required & Hired table.

Hourly wages and workers' fixed costs are calculated in the Base Hourly Wage Rates Plus Allowances table. To unadjusted hourly wage rates are added adjustments for vacation pay, statutory holiday pay, sick leave, retirement, and other allowances. These are entered as percentages of the unadjusted hourly wage rates. To the unadjusted rates are added annual fixed costs. These are entered as dollar amounts and include health insurance, liability insurance, labor accessories (from the next table), and other fixed costs.

Accessories used by individual workers are entered and tabulated in the Individual Worker Accessories Costs table. Such accessories might include ear muffs (hearing protection), gloves, hard hats, high-visibility vests, and safety boots. These are annual costs that are totalled in the Base Rate Plus Allowances table, above.

The Calculations portion of the *Wages* worksheet is divided into Shift hours required and Wages and hours calculations by worker type.

The Shift hours required calculation computes hours required by each employee type, depending on the number of operating shifts each year.

The Wages and Hours Calculation by Worker Type contains individual tables calculating total employment cost and hours worked for each worker type. For each worker type, if more hours are required than the standard hours available, then overtime hours will be automatically charged. If more overtime hours are required than are available, then the total remaining available hours will be negative and a warning will appear.

Crew Accessories Worksheet

The *Crew Accessories* worksheet does the costing calculations for gear that is used by the entire crew, rather than by individual workers. This includes fire and safety equipment, as well as loose tools. The cost of these tools is summed and divided by their expected operating life to give a daily cost.

These tools are technically chattels. That is, they should be capitalized and depreciated. However, the total cost of these accessories is so small compared with the total job cost that more accurate accounting for these capital costs would not significantly change the costings.

Administration Worksheet

The *Admin.* worksheet does the costing calculations for the administration expenses and the salaried employees' earnings. Administration expenses include fixed yearly salaries, clerical expenses, other professional fees, yearly communications expenses, and other overheads.

Other Costs Worksheet

The *Other Costs* worksheet is a template into which other costs that are not otherwise a part of the analysis may be incorporated. An example might be for road workers.

Working Capital Worksheet

The *Working Capital* worksheet calculates the amount of working capital required by year. Working capital is the funding needed for short-term financing of cash on hand, accounts receivable, inventory, etc. We assume that invested working capital is recovered at the end of the planning period.

Working capital and calculation of break-even log input costs present some difficulties. However, if working capital is not a significant proportion of total expenses, the effect on break-even calculations is not significant. See the discussion under the *Summary* worksheet description, above.

Capital Equipment Library Worksheet

The *Capital Equipment Library* worksheet is a place where costs and equipment capacities may be stored for individual pieces of equipment and for typical equipment configurations. Information may be copied from the *Capital Equipment Library* and directly into the *Capital Equipment* worksheet.

Model Assumptions

Incorporated into any model are critical assumptions that have a significant effect on results. If those assumptions are reasonable, then the model's results may be used as a reasonable guide. If those assumptions are not reasonable, then the model's results are worthless.

Like all models, LSY has some in-built assumptions.

- Inflation will affect all variables (except for depreciation) equally. Furthermore, all costs and revenues will increase annually at exactly the rate of inflation. If you believe that some costs are increasing faster than others, they may be individually adjusted.
- All cash flows occur at the end of each year. This is a basic simplifying assumption common to most discounted cash-flow analysis. In reality, cash flows occur throughout the year. However, the accuracy gained by trying to account for cash flow is lost in all the other assumptions (for example, inflation rate, interest rates, salvage value, repair and maintenance costs) that must be made.
- The loan interest rate will not be affected by the amount of gearing. Within reasonable gearing ranges, the loan interest rate will be approximately constant. A bank or finance company, however, would want a higher rate of return if the firm's gearing sets too high.
- Any tax losses will be deductible in the year in which they occur. Implicit in this assumption is a further one that tax losses may be deducted from income from some other source. As a result, losses are not carried forward. If losses did have to be carried forward, this would lower the owners' rate of return.

- Built into the capital equipment model is an assumption that the equipment will be replaced at the end of its economic life, which is measured in years. However, equipment maintenance depends on how intensively equipment is used. If the number of hours per shift or the number of shifts per year is increased, maintenance costs will increase along with other operating costs, but economic life will not change.

LSY Limitations

- LSY is not a production optimizer. That is, given the species and diameter distributions of log inputs along with the processing costs, grade specifications, demand quantities, and prices for the outputs, LSY will not tell the optimum production mix.
- Although LSY offers the option of leasing or purchasing land and buildings for the sort yard, the program is not structured to account for the possibility of leasing some or all of the capital equipment used in the yard.
- LSY does not calculate system capacity. That is, given a number of pieces of capital equipment, LSY will not calculate how many pieces or what volume that equipment configuration could handle. Similarly, LSY cannot be used to tell what system configuration will work best to handle a given mix and volume of logs.
- LSY does not calculate output products. Given a mix of logs, LSY cannot calculate the products that could be manufactured and sorted from that mix. You must specify both the input and output mix.
- Although LSY's log inputs and outputs do not have to be in the same units, all the log inputs (on the *General Assumptions* worksheet) and all the outputs (on the *Gross Margin* worksheet) should be in the same unit. The program is not set up to make conversions, for example, from tons to thousand board feet log scale.
- LSY is set up to automate a number of calculations related to cash flows generated by a log-sort yard. As with all computer programs, outputs are only going to be as good as the input data. If results of the model are not believable, there is probably a very good reason for it and the input data and assumptions should be carefully checked.

Running a Break-Even Log Costing in LSY

To determine a break-even log costing using the model, proceed according to the following steps:

1. Enter the required inputs (see Appendix 1).
2. Test the sensitivity of the inputs to changes in key variables. Suggested variables to test include the following:
    - Sales revenues (in *Summary* worksheet or in *Gross Margin*)
    - Log input costs (in *Summary* worksheet or in *Gross Margin*)
    - Owners' allowable return on risk capital (in *General Assumptions*)
    - Owners' debt percentage (in *Summary* worksheet)
    - Capital equipment costs (in *Summary* worksheet or in *Capital Equipment*)
3. Calculate the break-even log cost in the *Summary* worksheet using the "Optional summary log input cost." To do this, set all log costs in the *Gross Margin* worksheet equal to the Optional summary log input cost on the *Summary* worksheet. Then adjust the Optional summary log input cost so that the net profit (loss) in the Revenue & Cost Summary is just above it is $0.

    IMPORTANT! the Optional summary log input cost must be a number and not a reference to another cell.

You can do this manually, and if you do, a good guess for a break-even log cost is the calculated break-even log cost, just below the Optional summary log input cost. Although this calculated cost will not be exact, because of the interaction of log cost, inventory value, accounts payable, and working capital, it will be close.

WARNING! If you set the Optional summary log input cost equal to the Calculated break-even log cost, copy and paste the break-even value (not a cell reference) into the Optional summary log input cost. Otherwise there will be a circular reference in the Working Capital calculation. Alternatively, you can do this using the Goal Seek function within Microsoft Excel. To use the Goal Seek tool, after opening it, set the net profit (loss) in the Revenue & Cost Summary to $0 by allowing the program to change the Optional summary log input cost.

When the net profit (loss) is $0, it should say "Operation is at break-even (incl. profit allowance)" and the after-tax IRR should be equal to the after-tax WACC.

Conclusions

LSY is a large, powerful, and complex program. It can provide the focus for a pre-feasibility or financial feasibility analysis for a log-sort yard. It estimates cash flows for capital budgeting purposes. It can be used to estimate overall profitability or to calculate how much could be paid for logs and still break even. It can determine overall average manufacturing costs for an operation in which capital costs are varied and infrequent. It can identify which grades of input logs are the most and least profitable, and highlight any that can only be processed for a loss. It can also identify which products are the most profitable and which, if any, can only be produced for a loss. It can be used to plan hiring for the purposes of balancing fixed costs and overtime to minimize total wages costs. Built into the program is a feature to store capital cost data by machine type and equipment configuration so that costs of different options can be quickly compared. Sensitivity analysis scaling factors and cost contingency allowances are built in so that "what if" analysis may be quickly performed.

Although the program is powerful, this power does come at a cost. The program is large and complex and requires a user who is familiar with sort yards in order to provide realistic input data. It also requires someone familiar with financial feasibility analysis in order to understand which outputs are important for the particular scenario that is being tested. As with any financial feasibility analysis, if the outputs look too good to be true, something may be wrong with the input assumptions.

References

Bilek, E.M. (Ted). 2007. ChargeOut! Determining machine and capital equipment charge-out rates using discounted cash-flow analysis. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. General Technical Report FPL–GTR–171. 33 p. Available online: http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr171.pdf

Brealey, Richard A. and Stewart C. Myers. 1991. *Principles of Corporate Finance*. Fourth edition. International edition. New York: McGraw-Hill, Inc. pp. 1–125.

Dramm, J. R., R. Govett, T. Bilek, G.L. Jackson. 2004. Log sort yard economics, planning, and feasibility. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. General Technical Report FPL–GTR–146. 31 p. Available online: http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr146.pdf

Appendix 1—Log-Sort Yard User-Inputs by Worksheet

Summary

The *Summary* worksheet contains all the bottom line information: net present values, internal rates of return, break-even log costs, and 10-year cash flows. In addition, it contains variable inputs to allow users to conduct a sensitivity analysis.

Sort yard name is the name of the log-sort yard.

Year is the operating year for the costing. The year entered here is also referred to as Year 0. Year 0 is right now, today. Year 1 is exactly one year from today. Year 2 is exactly two years from today, etc.

Other identifying run codes are any other names or letters associated with the run to identify it.

Sensitivity analysis scaling factors are percentages that may be varied up or down from 100% to test the sensitivity of the net present values, rates of return, and break-even log costs to changes in various costs and revenues.

Cost contingency allowances are percentages that may be varied up or down from 0% to allow for a cushion from the point estimates for various costs. While the cost contingency allowances work in a similar fashion to the sensitivity analysis scaling factors, they may be adjusted independently of the sensitivity analysis to allow for greater uncertainty regarding various costs.

Optional summary log input cost are a cost that may be used to calculate the true break-even log cost. Alternatively, this cost may be used to quickly change all the log costs to see the effect on the financial indicators from changing log input costs. To use this cost, set the log costs on the *Gross Margin* worksheet equal to this cell. Make sure that this cell is an absolute number and not a reference to another cell.

Debt/total capital is the target debt ratio—the percentage of assets and working capital that is financed with debt. Note the built-in assumption that this ratio decreases over time as debt is paid off. When new assets are purchased, the ratio increases again. There is also a built-in assumption that all outstanding debt will be paid at the end of the planning period.

This number is important in order to determine debt, loan payments, and total equity capital. In turn, if the cost of debt differs from the cost of equity, the level of debt will have an effect on the weighted average cost of capital. This ratio affects loans on land and buildings, chattels, capital equipment, and working capital. It also affects the before-tax nominal weighted average cost of capital (WACC), as the WACC is a mix of the cost of debt and the cost of equity.

General Assumptions

The *General Assumptions* worksheet contains most of the general assumptions—assumptions that are used as inputs on more than one worksheet. Entering them here will change them automatically throughout the model.

Entered General Assumptions

Interest Rates

Bank deposit rate is the effective annual interest rate received for savings at the bank. The effective annual interest rate is the rate that would be charged if payments were received or due only once, at the end of each year. It is a nominal rate that includes inflation.

The bank deposit rate is used in the determination of the owners' before-tax nominal weighted average cost of capital.

Bank lending rate is the basic commercial credit rate open to the owners. It is an effective annual nominal rate. Here an average rate should be used reflecting both the short-term financing required for day-to-day operations and working capital and the longer-term financing required for capital equipment loans.

The bank lending rate is used in the costings for chattels, capital equipment, and working capital. It is also used as the cost of debt component in the determination of the before-tax nominal weighted average cost of capital.

Bank financing charge is a percentage of the loan amount paid up front, at the start of the loan.

The bank financing charge is used at the origination of all loans (mortgages, chattels, capital equipment, and working capital).

Inflation rate is the forecast average annual rate of inflation for costs and revenues in the logging industry. An appropriate inflation rate should be based on forecasts for the industry, rather than on general consumer products inflation.

The inflation rate is important because it affects the real weighted average cost of capital. It also has an effect on real depreciation rates and capital equipment charge-out rates using the break-even capital costing method. Built into the model is the assumption that all cash costs and all revenues will increase at the specified inflation rate.

Required pre-tax premium on risk capital is a nominal interest rate premium over and above the (safe) bank deposit rate that is appropriate for the owners to earn on their invested capital. It represents the risk that the owners bear by having funds invested in the logging industry rather than in the bank.

The required pre-tax premium on risk capital is included in the weighted average cost of capital.

Time to construct and start up (in months) is the time it takes to construct the sort yard and make it operational. All start-up costs are compounded forward to the start-up date (Year 0).

Ad valorem **(property tax) mill rate ($/$1000)** is the tax rate that applies to real property, chattels, and capital equipment. *Ad valorem* taxes are expressed as a mill rate, that is, $/$1000. For example, a mill rate of 32 represents an annual tax of $32 for every $1000 of net asset value. *Ad valorem* taxes are on the current value of land and buildings, and on the book value of chattels and capital equipment.

Income & Capital Gains Taxes

Income taxes include state and federal income taxes. The Combined tax rate assumes that state income taxes are deductible from federal income taxes. The formula is

Combined_tax_rate = (Federal_income_tax_rate + State_income_tax_rate)
– (Federal_income_tax_rate
× State_income_tax_rate)

These numbers are important to determine the after-tax rate of return on cash flows. Income taxes apply to all earned income and excess depreciation. That is, if an asset is sold for more than its book value, but less than its historic cost, the difference is charged as ordinary income.

Capital gains taxes apply to increases in asset values over and above their historic costs.

Social Security taxes are federal taxes that apply to both hourly wages and administrative salaries. The percentage applied as well as the maximum income that is taxed are entered. This calculation does not incorporate the effect of individual workers' decisions regarding flexible spending accounts.

Medicare is a federal tax on wages and salaries.

Workers' compensation is a tax on wages and salaries that varies by state.

Unemployment insurance is a tax on wages and salaries with federal and state components. The federal component is similar to Social Security in that is a percentage and a maximum wage or salary is taxed. The state component may be structured in similar manner to the federal component, but rules and regulations will vary.

Calculated Weighted Average Cost of Capital (WACC)

Before-tax nominal WACC is a weighted average of (the Bank deposit rate + the Required return on risk capital) times the owners' equity percentage, plus the Bank lending rate times the owner's debt percentage.

Before-tax real WACC

[(1 + Before-tax nominal WACC)/(1 + Inflation rate)] – 1

After-tax nominal WACC

Before-tax nominal WACC × (1 – (Combined_income_tax_rate))

After-tax real WACC
[After-tax nominal WACC / (1 + Inflation rate)] – 1

Equity/Total capital: 1 – Target_debt_ratio

System Capacity

Total shift capacity

Costings are based on the amount of wood processed per standard operating shift. The capacity may be based either on the number of pieces/shift or on volume, represented by MBF/shift. Although one should be checked (with "√" or "x"), the default is pieces/shift.

Facility full-time operation shift hours

Operating days/year is the number days/year each shift will be operating when the yard is operating full-time.

Note that although these provide the inputs for the full-time operating capacity, the amount of capacity used is entered separately for each year.

Operating days/year is used in the calculation of shift hours/year. Ultimately, these figures are used in wages calculations, equipment costings, and production calculations.

Standard hours/shift is the number of hours each shift will operate. This number is used to calculate the shift hours./year. Standard hours/shift is used in the calculation of shift hours/year. Ultimately, these figures are used in wages calculations, equipment costings, and production calculations.

Capacity Utilization

Percent of full-time operation utilized are percentages by year of as the facility's full-time operation, as defined by you. The numbers are used to calculate the number of shifts/year. They could be used to show that at first only one shift/year is operating, but in later years that two, three, or more shifts are operating.

Percent of total operating capacity utilized are percentages of the system full-time capacity operating capacity defined previously.

These percentages are used to calculate the number of pieces and volume processed. They may be used to represent decreased efficiencies when the facility is new (that is, workers will be less efficient when they begin and more efficient as they gain more experience working with the equipment and together).

Resource Supply

Piece size or Volume Distribution is a table indicating the percentage of total input pieces or volume by butt diameter over the 10-year planning horizon.

Piece and volume count calculators are provided at the bottom of the worksheet to aid in calculation of the percentage distribution of pieces processed (if the volume distribution is known) or the volume processed (if the number of pieces processed is known). In both these calculations, the volume/piece input in this table is a critical input.

Piece size distribution with pieces fixed or Piece size distribution with volume fixed is a table calculating the total input pieces (pieces/shift) by butt diameter over the 10-year planning horizon. The exact title of this table will depend on whether the system capacity is limited by pieces/shift or by thousand board feet (MBF)/shift.

Note that piece count and volume count calculators are provided at the bottom of the worksheet to aid in the calculation of the number of pieces processed (if the volume distribution is known) or the volume processed (if the number of pieces processed is known).

Volume distribution with pieces fixed or Volume distribution with volume fixed is a table calculating the total input volume (MBF/shift) by butt diameter over the 10-year planning horizon. The exact title of this table will depend on whether the system capacity is limited by pieces/shift or by MBF/shift.

Note that piece count and volume count calculators are provided at the bottom of the worksheet to aid in the calculation of the number of pieces processed (if the volume distribution is known) or the volume processed (if the number of pieces processed is known).

Piece count calculation (pieces/year) is a table calculating the total input pieces processed (pieces/year) by butt diameter over the 10-year planning horizon.

The totals from this table are used in the *Wages and Capital* equipment worksheets to calculate productivity.

Volume calculation (MBF(input)/year) is a table calculating the total input volume processed (MBF/year) by butt diameter over the 10-year planning horizon.

The totals from this table are used in the Wages and Capital equipment worksheets to calculate productivity.

Piece count and volume count calculators (used to aid in calculating appropriate pieces/shift and volumes/shift)

Piece count calculator (if volume distribution is known) Given total volume processed (MBF/shift); the percentage distribution of volume/shift by butt diameter size class; and the volume per piece (MBF/piece), the table calculates pieces/shift by diameter class and total pieces/shift; the percentage distribution of pieces/shift by diameter class; and volume processed (MBF/shift) by diameter class.

Volume calculator (if piece count distribution is known) Given total pieces/shift processed; the percentage distribution of pieces/shift by butt diameter size class; and the volume per piece (MBF/piece), the table calculates the volume/shift by diameter class and total volume/shift; the percentage distribution of volume/shift by diameter class; and pieces processed (pieces/shift) by diameter class.

Gross Margin

The *Gross Margin* worksheet calculates the gross margin (sales revenue minus log input cost) for each year of the planning period. All the costs and revenues entered on this sheet are in pre-start-up dollars. That is, they will be increased by the specified inflation rate over the start-up period and for the first year.

The model allows you to specify up to 20 different log input grades. The grades should be based either on different input prices for the different grades, or on different products or different product prices that could be produced from the input grades. The grades could be divided by species, such as pine veneer log; pine large saw log, pine small saw log, pine pulpwood, pine unmerchantable; fir veneer log; fir large saw log, and fir small saw log.

The model allows you to specify up to 19 different products. Each product may have a different price, depending on what log grade it is produced from. The combined product output price matrix allows for a total of 380 different product prices, although that amount of detail is not warranted unless there is also detailed and accurate log supply and product recovery information by log input grade.

The inputs required on this worksheet are as follows:

Year 0 product output prices are by product output and log input grade name. The prices are as of the start-up date of the yard.

Year 0 log costs are by log input grade. The prices are as of the start-up date of the yard. This table also contains a column for the production volume loss by log input grade. The production volume loss is losses in the input volume because of trimmings, shrinkage, and degrade.

To calculate the break-even log cost, set these Year 0 log costs equal to the Optional summary log input cost on the *Summary* worksheet or from the Assumptions above. Then on the *Summary* worksheet, either use iterative calculations or Goal Seek (in the Tools menu), setting the Net profit (loss) equal to $0 by changing the Optional summary log input cost.

Operationally, this section may also be used to find the marginal value of an additional log species or grade, given other log costs and returns, and the projected revenue from new log species or grade. First, make sure that the log cost on the new species or grade is an absolute number (not a cell reference). Use Goal Seek, setting the net profit (loss) on the *Summary* worksheet to $0 by changing the log cost on the new species or grade on this worksheet. The resulting log cost will be the maximum amount that can be paid for the new logs and still provide the owners with their specified rate of return.

Input log mix percentages are by log input grade by year over the 10-year planning period. They allow the analyst to change the input grade mix to reflect the possible changing nature of the resource. The percentages should be worked out with a resource or procurement forester.

Product recovery percentages are by log input grade and product type. They show the percentage of each log input grade that will go into each output grade. The product recovery percentages should be put together with the production and marketing managers. The marketing manager should be able to recommend which possible log manufacturing products would be preferable from either a price or a volume perspective.

Consolidated Operating Costs

The *Consolidated Operating Costs* worksheet has no user-defined inputs, but consolidates the operating costs from all the subsidiary worksheets.

Land & Bldg.

The *Land&Bldg.* worksheet provides the costing information for the real estate portion of the project. The user-defined inputs on this worksheet are broken down into various input tables.

General assumptions

Some of the general assumptions are imported. Those that you must provide on this worksheet follow.

Mortgage term (years) is the number of years to use in the calculation of the mortgage payment.

Bank mortgage interest rate is the interest rate charged by the bank on its mortgages for land and buildings.

Land

The inputs for the land costing follow.

Initial bare land purchase price ($/acre) is the cost of the land, including non-deductible improvements. Such improvements include "…public utility initial clearing and grading land improvements as specified in Rev. Rul. 72-403, 1972-2 C.B. 102" (Internal Revenue Service. 2000. Table B-1. P.90).

Land area required (acres)

The land area required for the log-sort yard.

Real annual increase (decrease) in land value allows for increases or decreases in land prices that are faster than inflation. The real increase (decrease) is in addition to inflation. If land changes in value at the same rate as inflation, then this value should be 0%.

Annual land lease cost ($/acre)

This figure is not needed if the land is purchased.

Annual R&M expense (pct. of current capital value) is the expense for repairs and maintenance on the land (plowing, fire protection, etc.).

Annual insurance expense (pct. of current capital value) is the expense for property insurance on the land.

Buildings

Initial building purchase/construction cost is the cost to purchase or construct the building.

Real annual increase (decrease) in building value allows for increases or decreases in building values that are faster than inflation. The real increase (decrease) is in addition to inflation. If buildings change in value at the same rate as inflation, then this value should be 0%.

Annual building lease cost ($): this figure is not needed if the building is purchased.

Annual R&M expense (pct. of current capital value) is the expense for repairs and maintenance on the buildings.

Annual insurance expense (pct. of current capital value) is the expense for property insurance on the buildings.

Payment method indicates whether land and buildings are either purchased or leased. One should be selected with a check (√) or an "x."

Depreciable land improvements include roads, fences, a water system, and other improvements.

The IRS allows depreciation expense using either straight line or declining balance depreciation on depreciable land improvements. If declining balance depreciation is used, then the maximum allowable declining balance factor is 150%.

Buildings

The IRS allows only straight-line depreciation over either 39 years or 50 years to be used for buildings.

Chattels

Chattels include all long-term assets in a project that are not real estate or capital equipment. Chattels include weigh scales, sorting bunks, computers and peripheral equipment, office machinery, and office furniture and fixtures. Although the term, "chattels" could also apply to inventory and loose tools, those assets are accounted for elsewhere.

The inputs required on this worksheet follow.

Insurance (pct. of replacement cost) is insurance for the chattels.

No. required is the number of machines of each type that are needed.

Cost/unit is the Year 0 cost for the chattels.

Annual R&M pct. of straight-line depreciation is repairs & maintenance as a percentage of straight-line depreciation taken over the asset's economic life.

General Depreciation System (GDS) life (years) is the chattel's life using the general depreciation system. GDS values come from IRS tables. See for example: Department of the Treasury, Internal Revenue Service. 2000. Publication 946, "How to Depreciate Property."

ADS life (years) is the chattel's life using the alternative depreciation system.

ADS values come from IRS tables. See for example: Department of the Treasury, Internal Revenue Service. 2000. Publication 946, "How to Depreciate Property."

Economic life (years) is the chattel's actual estimated useful life.

The economic life may be greater or less than the depreciable life allowed by the Internal Revenue Service. The asset will be automatically replaced at the end of its economic life. The replacement price will be the original cost plus an inflation adjustment.

Salvage estimate is the estimated value, in Year 0 dollars at the end of the economic life.

The salvage estimate is used for current value calculations. These values are automatically increased for inflation.

Depreciation method is a code for the depreciation method used. The methods and the codes are the same as for buildings.

Note that the depreciation codes under the individual chattels may be entered separately. However, they are presented in **black** because they are linked to the Depreciation method input in the General Entered Assumptions. Usually the depreciation method used will be the same for all chattels.

For tax purposes, chattels may be depreciated using either straight-line or declining-balance depreciation. The depreciation codes are as follows:

DB—declining-balance (This feature will automatically switch to straight-line depreciation if the latter offers a higher write-off);

SLA—Straight-line depreciation over an asset's recovery period specified by the Internal Revenue Service (IRS) under the (GDS). The periods are generally shorter and offer accelerated or higher depreciation compared with the IRS-allowed Alternative Depreciation System.

SLADS—Straight-line depreciation over an asset's recovery period specified by the IRS under the Alternative Depreciation System (ADS). These periods are generally longer and offer smaller depreciation write-offs each period compared with the recovery periods allowed under the IRS-allowed General Depreciation System.

SLEL—Straight-line (economic life) depreciation over an asset's economic life is not an IRS-approved method.

K—"K"ustom (The IRS would only approve "Kustom" depreciation if it followed an IRS-approved method.)

Declining-balance factor is a percentage used in declining balance depreciation.

With chattels, a maximum of 200% is currently allowed. This is known as "double declining-balance depreciation." Using a declining-balance factor of 200% allows for a faster write-off and greater tax savings, provided that there is sufficient offsetting revenue. The IRS also allows a factor of 150%.

Capital Equipment Library

The *Capital Equipment Library* is the final worksheet in the model. Its use is optional. It holds data on machinery and equipment and machinery and equipment configurations that might be used in the log-sort yard. Data for the machines may be entered individually by machine type. Alternatively, it may be entered by system configuration. The data in the capital equipment library is meant to be copied and pasted into the table, Entered Assumptions by Capital Equipment Type on the *Capital Equipment* worksheet as needed.

System description name identifies the combination of equipment used.

Expected average productivity (either pieces/shift or MBF/shift) is the base input processing productivity expected from this combination of capital equipment.

Capital equipment name is the name of the equipment used.

Initial cost is the Year 0 cost of the equipment. The replacement cost of this equipment will be increased for inflation.

GDS life (years) is the equipment's' depreciable life under the general depreciation system (see: IRS Publication 946).

ADS life (years) is the equipment's' depreciable life under the alternative depreciation system (see: IRS Publication 946).

Economic life (hours) is the equipment's' practical operating life in hours. The expected operating life (hours) is used in calculating repairs and maintenance costs. The economic life in hours divided by the economic life in years provides an economic constant hours/year. If the equipment is used more than this rate, then repairs and maintenance will be increased.

Economic life (years) is the equipment's' practical operating life in years.

The expected operating life (years) is used in calculating repairs and maintenance costs. It is also used to determine the year(s) in which the equipment will be replaced.

Salvage estimate is used for current value calculations and to determine capital gains or losses when the equipment is sold.

The salvage estimate is the estimated value, in Year 0 dollars, at the end of the equipment's economic life. These values are automatically increased for inflation.

Kilowatts is the size of the diesel engine.

The size of the engine, combined with the fuel consumption rate provides the hourly fuel consumption (gal/hour).

Fuel consumption (gal/Kw/hr) is the rate of fuel consumption.

The rate of fuel consumption, combined with size of the engine, in kilowatts, provides the hourly fuel consumption (gal/hour).

Oil & lube (% of fuel) is a percentage of total fuel cost.

Other annual costs ($/year) are any other annual costs.

Avg. annual R&M (%)

Average annual repairs and maintenance are an estimated percentage of the economic life depreciation. Repairs and maintenance will be increased if the equipment is used more hours than its average annual economic rate (the economic life in hours divided by its economic life in years). It will be decreased if the equipment is used fewer hours than its average annual economic rate.

Depreciation method is a code for the depreciation method used. The methods and the codes are the same as for chattels (above).

Note that the depreciation codes under the individual pieces of capital equipment may be entered separately. However, they are presented in **black** because they are linked to the Depreciation method input in the General Entered Assumptions. Usually the depreciation method used will be the same for all pieces of capital equipment.

For tax purposes, capital equipment may be depreciated using either straight line or declining balance depreciation. The depreciation codes follow.

- DB—declining-balance (note that it will automatically switch to straight line depreciation if the latter offers a higher write-off)
- SLA—Straight-line (depreciation, accelerated)
- SLADS—Straight-line (depreciation system)
- SLEL—Straight-line (economic life). Straight-line depreciation over an asset's economic life is not an IRS-approved method.
- K—"K"ustom. The IRS would only approve "Custom" depreciation if it followed an IRS-approved method.

Declining-balance factor is a percentage used in declining-balance depreciation. With capital equipment, a maximum of 200% is currently allowed. This is known as double declining-balance depreciation. Using a declining-balance factor of 200% allows for a faster write-off and greater tax savings, provided that there is sufficient offsetting revenue. The IRS also allows a factor of 150%.

No. used is the number of pieces of capital equipment of each type that are used.

Total operating hours/shift is the number of hours/shift that all the equipment in this category is operating.

If two or more identical pieces of equipment are in any category, then enter the total number of hours for all of the pieces of equipment in that category here (e.g., if two identical loaders are each operating for 7 hours during each shift, then enter "14" for the loaders in Hours/shift).

Wages

The *Wages* worksheet contains the inputs and calculations for the wages costings for the hourly wageworkers. It does not contain information or calculations for the salaried employees. Their earnings are calculated on the *Admin*. worksheet. The inputs on the *Wages* worksheet are divided into four input tables:

- Employees Required & Hired
- Standard Work Hours and Available Overtime Hours per Worker
- Base Hourly Wage Rates plus Allowances by Worker Type
- Individual Worker Accessories Costs

Employees required & hired contains the basic inputs on the workers required and actually hired by year. The inputs follow.

Worker type is the different worker classifications required for the yard (e.g. scalers, graders, equipment operators).

Employees required (no./shift) is the number of employees in each worker type classification that are required for each operating shift.

In this entry, only whole numbers are allowed, which means no fractional employees. The number of worker hours required will depend on the number of employees required, the number of hours/shift, and the number of shifts/year.

Employees hired (no.) is the actual number of employees hired in each worker type by year.

If the number of employees hired in any worker type for any year is less than is actually required, a warning will appear. If a warning does appear, then you should scroll down to the individual worker categories to determine in what year or years more workers are required. The only way to eliminate these warnings is to hire more workers in the appropriate years, or to increase the maximum work days/year or the maximum work hours/day.

IMPORTANT! Hiring additional employees may reduce the total wages bill. Depending on how much extra employees are paid for working overtime and the fixed costs/employee, it may be possible to reduce the total wages bill by hiring additional workers in some years. These numbers are worth experimenting with.

Standard work hours per worker calculates the number of hours that workers will earn their adjusted hourly wage rates. The required inputs follow.

Days/year

Usually this number will be 365.

Less: Holidays

These are statutory holidays. Currently the 10 Federal holidays are as follows:

- New Years Day
- Birthday of Martin Luther King, Jr.
- Washington's Birthday
- Memorial Day
- Independence Day
- Labor Day
- Columbus Day
- Veterans Day
- Thanksgiving Day
- Christmas Day

Less: weekend days

Although workers may be required to work on weekend days, or more than five days/week, these are days for which an employee working will be paid an overtime allowance.

Less: vacation days (optional) are the workers' annual vacation days.

Less: allowed sick days (optional) are the expected days that workers will not be on the job because of illness.

Available overtime hours per worker calculates the number of hours that workers could earn their adjusted hourly wage rates plus an overtime allowance. The required inputs follow.

Maximum work days/year is the number of days that a worker could potentially work.

Maximum work hours/day is the maximum time that a worker could possibly work.

The Base Hourly Wage Rates plus Allowances by Worker Type input table calculates ordinary base rates, overtime, and annual fixed costs. The required inputs followed.

Unadjusted hourly wage rates is the base hourly rates that employees will see in their paychecks.

Statutory holiday pay is a percentage applied to the unadjusted hourly wage rates to account for paid holidays.

Vacation pay is a percentage applied to the unadjusted hourly wage rates to account for paid vacation days.

Sick leave is a percentage applied to the unadjusted hourly wage rates to account for paid sick leave.

Retirement is a percentage applied to the unadjusted hourly wage rates to account for payments to worker retirement funds.

Other allowances is a percentage applied to the unadjusted hourly wage rates to account for any other worker allowances.

Hourly overtime factor is a percentage applied to the adjusted hourly wage rates for overtime hours worked.

Annual fixed costs/employee calculates the fixed costs associated with hiring each employee. The fixed costs are in terms of dollars. They are as follows:

- **Health insurance** is the charges for worker health insurance paid by the firm.
- **Liability insurance** is the liability insurance carried by the firm.
- **Labor accessories (from below)** is the worker accessories paid for by the firm.

This amount is imported from the Individual worker accessories costs input table below.

Other fixed costs is any additional fixed costs/employee.

H2 Crew Accessories

Crew accessories contain general accessories for the crew, including the fire and safety equipment. Although they would be itemized and depreciated as chattels for accounting purposes, they are likely to be only a small proportion of the total costs.

Fire is all fire tools, pumps, extinguishers, etc.

Safety is gang safety equipment.

Loose tools is a single number quantifying the value of miscellaneous loose tools.

Tool and equipment operating life is an estimate for the tool and equipment life to calculate an annual allowance.

Administration

The *Admin*. worksheet contains costs that account for the salaried employees, clerical expense, etc. Inputs required follow.

Salaried employees required is the number of salaried employees each year by employee classification.

Fixed costs per salaried employee (Year 0) is fixed costs include ordinary salary, a perks percentage (e.g., company vehicle), health insurance, liability insurance, and other costs for each salaried employee classification. All costs are in Year 0 dollars.

Yearly clerical expense calculations is the yearly clerical expense calculations require the input of clerical hours (hours/year), the clerical cost ($/hour), the wages preparation cost ($/year/employee), and other clerical costs ($/year).

Other professional fees include accounting, legal, and other professional fees.

Communications expenses are any communications expenses including telephone, fax, cell phones, and Internet service.

Other overheads expenses ($/year) includes utilities, other insurance, bank overdraft charges, etc.

Other Costs

Other costs is a catch-all for costs that have not been entered elsewhere. These costs are all entered individually.

Working Capital

The *Working capital* worksheet contains the calculations for the short-term funding that the firm requires to operate. In an accounting sense, working capital is defined as current assets minus current liabilities. Current assets represent short-term funds that are needed (cash on hand, accounts receivable, and inventory are usually the three largest components). Every firm needs to finance its current assets. If it does not, a liquidity crunch could mean lost investment opportunities. At the extreme, it could mean that the firm is put into bankruptcy or receivership.

The most common method of funding current assets is with current liabilities. Accounts payable and bank overdraft are the two most common forms.

Working capital is paid back at the end of the 10-year planning period.

The inputs required to calculate working capital follow.

Required cash on hand (percent of sales) is the cash necessary for day-to-day operations.

Average pre-sort holding period is the number of days that the unsorted logs are in inventory before being sorted. The pre-sort inventory valuation is based on the delivered cost of the input logs.

Average post-sort holding period is the number of days that the sorted logs are in inventory before being sold.

The post-sort inventory valuation is based on the delivered cost of the input logs, the cost of sorting, and the expected volume loss during the sort process.

Average days to collect accounts receivable is the number of days that need to be financed. The sooner that accounts can be collected, the better it is for cash flows and also for the probability of collection. It may be possible to shorten collections by offering a lower price for prompt payment.

Average days to pay accounts payable is the number of days available from creditor financing. The longer that account payment can be delayed, the better it is for cash flows, provided that there are no early payment discounts. Note, however, that if accounts payable are regularly paid late, the firm may develop a bad credit rating.

Appendix 2—Log-Sort Yard Selected Worksheet Printouts for a Sample Run

Version: B9. FPL draft version
June 12, 2008

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General Warnings

- The input data provided are for illustrative purposes only. They should not be taken to represent the activities of any log-sort yard.
- The input data provided will need to be modified to represent the activities of any sort yard.

Disclaimers

- This model is released on an "as is" basis. Although the author has extensively tested the model, it is not guaranteed to be free of errors under all calculation scenarios.
- The results of the model will only be as good as the input data. If the input data are poor, the results cannot be expected to be reliable.
- All financial planning models involve forecasts of the future. The results of the model will only be as valid as those forecasts.
- Conditions may change to make the forecasts invalid (e.g., labor becomes unavailable so that wages have to increase rapidly, a fire shuts down operations or makes log supplies unavailable, market conditions change so that product prices increase or decrease, or interest rates change). Although the model enables a sensitivity analysis to be run to see which of the forecast variables are the most critical to the model's results, if the forecasts are invalid, the model's results will also be invalid. If the underlying assumptions change, the model should then be re-run.
- Neither Ted Bilek nor the U.S. Forest Service will accept any liability for losses resulting from reliance on the model's results. However, the author hopes that use of the model will provide improved information for decision-making in the set-up and operation of log-sort yards.
- Depreciation rates may be changed according to standard depreciation schedules, or custom rates may be used.
- The model allows users to store data on equipment costs and productivities so that comparisons may easily be done on different equipment and sorting-system configurations.
- Terminal values may be based on either current or book values.
- The model includes sensitivity analysis options to scale costs and revenues up or down.

Please report any errors or suggestions for improvements directly to the author.

Introduction

LSY is a spreadsheet-based model that can aid in the pre-feasibility and financial feasibility analysis of a log-sort yard. The model is meant to be used with the following documentation:

Bilek, E.M. (Ted). 2009. LSY: A spreadsheet tool to evaluate log-sort yard economics. U.S. Department of Agriculture, Forest Service. Forest Products Laboratory. General Technical Report FPL-GTR-184. Available online: http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr184.pdf

What The Model Does

- Standard financial measures, net present value (NPV) and internal rate of return (IRR) are calculated before tax and finance, before tax, and after tax.
- Yearly summaries may be used for marketing and budgeting purposes. Yearly summaries include cash flows; productivity measures; physical log input requirements; and physical outputs by product type.
- The break-even log cost shows how much the yard could afford to pay for logs and still make its specified after-tax rate of return.

The Model Is Flexible

- Users can easily and quickly change variables and determine the effect on financial feasibility.
- The model allows users to specify up to 20 log input grades and 19 product outputs.
- The percentage composition of logs coming in may be varied over time.
- The model is set up so that users may limit production by number of pieces or thousand board feet.
- The model allows changing hours of operation over time.
- The model allows users to specify a learning curve, if desired, to represent increased efficiencies over time as workers become more familiar with the operation.
- Land and buildings may be leased or owned.
- Pieces of equipment may have different economic lives than depreciable lives.
- Depreciation rates may be changed according to standard depreciation schedules, or custom rates may be used.
- The model allows users to store data on equipment costs and productivities so that comparisons may easily be done on different equipment and sorting system configurations.
- Terminal values may be based on either current or book values.

- It includes sensitivity analysis options to scale costs and revenues up or down.

The Model Is Powerful

- Break-even log costs are approximated through direct calculations so that the difference between the actual log cost and the break-even cost may easily be seen.
- Exact break-even costs may be determined easily using Excel's built-in "Goal Seek" function.
- The model allows users to see which log input types and products are the most profitable and which, if any, are losing money.
- Wages calculations show years in which more hourly employees are required and what worker classifications are needed.
- Numbers of employees may be changed to minimize wages expenses.
- Sensitivity analysis may be run on any of the cost categories or prices by simply changing percentages on the *Summary* worksheet.
- Equipment is assumed to wear out at the end of its economic life, which may be different than its depreciable life.
- Worn out equipment is automatically replaced at an inflation-adjusted cost.
- Inflation is incorporated into the model. If an inflation rate is specified, all revenues and all costs, apart from depreciation, will increase at the specified rate.
- Financing may be incorporated into the model.

The Model is Organized for Ease of Use

- All assumptions that may be changed are entered in **blue.**
- The most important information is consolidated on the *Summary* worksheet.
- A full sensitivity analysis may be run without leaving the *Summary* worksheet.
- Inputs that are used in more than one worksheet are only entered once, in the general assumptions worksheet.
- Inputs that are specific to just one worksheet are entered on that worksheet.
- The most important information is at the front of the workbook and at the top of each worksheet. Assumptions always come next.
- Costs are consolidated in one worksheet. Further information is provided in the individual costing worksheets.
- Cells containing costs and revenues that are used in the *Summary* worksheets are highlighted in yellow.
- Equipment costs and productivities may be copied from the equipment library and pasted into the equipment worksheet.
- Extensive error and warning messages designed to aid in the interpretation of the results may appear, depending on the input assumptions.

Limitations

- This is a very big spreadsheet/workbook with over 150 pages in hard copy. Its size may appear to be overwhelming.
- LSY is not for those without a background in business finance and logging operations. Whereas the program contains the structure to analyze pre-feasibility and feasibility for a log-sort yard, assembling the necessary data will take a team involving the skills of a logging engineer, log yard operations manager, procurement forester, marketing specialist, and financial analyst/accountant.
- LSY does not provide pro-forma income statements and balance sheets, but it could provide the basis to do so.
- LSY does an analysis based on a "for profit" business. This is the recommended approach for all log-sort yards.
- See the following background paper for further information: Dramm, John Rusty, Robert Govett, Ted Bilek, Gerry L. Jackson. 2004. Log-sort yard economics, planning, and feasibility. U.S. Department of Agriculture, Forest Service. Forest Products Laboratory. General Technical Report FPL-GTR-146. 31 p. Available online: http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr146.pdf.

Workbook Contents

Summary is a summary of all the financial and physical measures.

The Summary worksheet also contains the inputs for a sensitivity analysis and log cost break-even calculation.

Pie Chart shows all the discounted cost categories, in addition to profit (loss) as a percentage of discounted sales revenue.

Cash Flow Chart is a line graph showing annual cash flows before finance and tax, before tax, and after tax.

General Assumptions is a worksheet containing all assumptions that are inputs to more than one subsequent worksheet.

Gross Margin: gross margin = product sales – log costs. The gross margin is what is left over to cover the yard's operating costs.

Consolidated Operating Costs worksheet contains the costs consolidated from the subsequent worksheets.

Land&Bldg. is the area required for operation. It may be leased or purchased. The cost includes repairs and maintenance. Depreciation on depreciable land improvements and buildings is allowed if the assets are purchased.

Chattels contains the depreciable office equipment. It also contains weigh scales and sorting bunks.

Capital Equipment is the equipment used for sorting.

Wages are the workers who work for hourly wages. This worksheet does not include administration and overhead wages. They are entered on the *Admin. And Other* costs worksheets.

Worker Accessories is primarily site safety equipment.

Admin. is administration costs and overheads.

Other Costs contains miscellaneous other costs.

Working Capital is a function of required cash on hand, accounts payable, accounts receivable, log input inventory, and sorted product inventory. Working capital is repaid at the end of the project.

Capital Equipment Library: worksheet allows equipment specifications to be saved by equipment type and also by equipment configurations. Data from this worksheet may be pasted into the capital equipment worksheet to quickly change equipment configuration scenarios.

LOG SORT YARD SUMMARY FOR **BIG ONION RIVER SORT YARD** **2008**

Other identifying codes for the run: Example data may not be representative of actual revenues or costs

IMPORTANT! Assumptions in blue must be entered.

System 1 configuration **No. of sorting machines: 6**

FINANCIAL INDICATORS	Net present value	Nominal IRR	Real IRR
Before finance & tax	$ 1,545,605	21.6%	18.1%
Before tax	$ 1,728,811	28.3%	24.6%
After tax	$ 808,482	14.3%	10.9%
		IRR Test =	10%

WARNING! Multiple changes in signs in your cash flows mean there may be more than one after-tax internal rate of return.

COSTS OF CAPITAL[1]	
Nominal before-tax weighted average cost of capital	11.60%
Nominal after-tax weighted average cost of capital	6.99%
Real after-tax weighted average cost of capital	3.88%

[1] Imported from the Gen. Assumptions worksheet

REVENUE & COST SUMMARY	After-tax PV	$/Piece (input)	$/MBF (input)	$/MBF (output)	Pct. of sales
Gross revenue					
Sales revenue	$ 73,211,307	13.51	340.36	358.27	100.0%
Log costs	(47,752,761)	(8.81)	(222.00)	(233.68)	-65.2%
Subtotal: gross margin	$ 25,458,546	$ 4.70	$ 118.36	$ 124.58	34.8%
Operating costs					
Capital costs	$ (5,396,295)	(1.00)	(25.09)	(26.41)	-7.4%
Direct production costs	(11,162,706)	(2.06)	(51.89)	(54.63)	-15.2%
Fixed costs and overheads	(5,914,096)	(1.09)	(27.49)	(28.94)	-8.1%
Working capital	(270,553)	(0.05)	(1.26)	(1.32)	-0.4%
Subtotal: operating costs	$ (22,743,650)	$ (4.20)	$ (105.73)	$ (111.30)	-31.1%
Financing and taxes					
Financing	(81,138)	(0.01)	(0.38)	(0.40)	-0.1%
Capital gains and income taxes	(1,825,276)	(0.34)	(8.49)	(8.93)	-2.5%
Subtotal: financing and taxes	$ (1,906,414)	$ (0.35)	$ (8.86)	$ (9.33)	-2.6%
Net profit (above cost of capital)	**$ 808,482**	**$ 0.15**	**$ 3.76**	**$ 3.96**	**1.1%**

Note: to calculate the true break-even log cost, either iteratively or using Goal Seek, set the After-tax PV of the Net profit (loss) above to $0 by changing the optional summary log input cost, below.

SENSITIVITY ANALYSIS SCALING FACTORS	
Sales revenues	100.0%
Log costs	100.0%
Land & bldg.	100.0%
Chattels	100.0%
Capital equipment	100.0%
Wages	100.0%
Crew accessories	100.0%
Administration	100.0%
Other costs	100.0%
Working capital	100.0%

COST CONTINGENCY ALLOWANCES	
Capital costs	30%
Direct production costs	15%
Fixed costs and overheads	10%
Working capital	10%
Debt/Total capital	40%

BREAK-EVEN AND PROFIT SUMMARIES	Year 0 value	Year 1 value
Optional summary log input cost ($/MBF input)	$ 228.26	$ 235.10
Calculated avg. break-even log cost ($/MBF input)	$ 228.22	$ 235.07
Actual weighted-avg. log input cost ($/MBF input)	222.00	228.66
Estimated pre-tax net profit ($/MBF input)	$ 6.22	$ 6.41
Actual weighted-avg. product value ($/MBF output)	$ 358.27	$ 369.02
Calculated avg. break-even product value ($/MBF output)	351.72	362.27
Estimated pre-tax net profit ($/MBF output)	$ 6.55	$ 6.75
Calculated avg. break-even log cost ($/piece input)	$ 9.06	$ 9.33
Actual weighted-avg. log cost ($/piece input)	8.81	9.08
Estimated pre-tax net profit ($/piece input)	$ 0.25	$ 0.26

Figures for SUMMARY Chart	
Log costs	65.2%
Capital costs	7.4%
Other operating costs	23.7%
Financing and taxes	2.6%
Net profit	1.1%

WARNING! The entered log input cost on the Gross Margin worksheet for at least one log input catagory is not equal to the Optional summary log input cost above.
NOTE: unless both inventory and accounts payable make up a significant portion of the total costs, and working capital makes up a significant portion of total costs, the difference between the calculated break-even log cost and the true break-even log cost will not be significant.

CASH FLOW SUMMARY	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cash flow before tax and finance	$ (3,365,021)	$ 676,021	$ 1,296,352	$ 1,195,960	$ 62,825	$ 1,200,672	$ 601,171	$ 918,159	$ (1,313,726)	$ 1,108,815	$ 3,192,938
Cash flow before tax	$ (2,330,861)	$ 638,908	$ 1,039,702	$ 938,235	$ 166,150	$ 932,019	$ 639,798	$ 820,407	$ (736,917)	$ 794,141	$ 1,889,918
After tax cash flow	$ (2,301,089)	$ 517,522	$ 761,453	$ 613,894	$ (178,155)	$ 680,321	$ 276,110	$ 489,182	$ (1,054,211)	$ 751,999	$ 1,624,288

WARNING! Multiple changes in sign from positive to negative and back again in your cash flows mean that there could be more than one internal rate of return.

PRE-TAX PROFITABILITY AND BREAK-EVEN LOG COST ESTIMATE	Present value	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Product sales ($)	$ 73,211,307	$ 9,240,908	$ 9,518,135	$ 9,803,679	$ 10,097,789	$ 10,400,723	$ 10,712,745	$ 11,034,127	$ 11,365,151	$ 11,706,105	$ 12,057,289
Break-even recovery of operating costs ($)	(24,119,846)	(3,044,465)	(3,135,799)	(3,229,873)	(3,326,769)	(3,426,572)	(3,529,370)	(3,635,251)	(3,744,308)	(3,856,637)	(3,972,337)
Maximum break-even log costs	$ 49,091,460	$ 6,196,443	$ 6,382,336	$ 6,573,806	$ 6,771,020	$ 6,974,151	$ 7,183,375	$ 7,398,876	$ 7,620,843	$ 7,849,468	$ 8,084,952
Actual log costs	(47,752,761)	(6,027,469)	(6,208,293)	(6,394,542)	(6,586,378)	(6,783,969)	(6,987,488)	(7,197,113)	(7,413,026)	(7,635,417)	(7,864,479)
Pre-tax profit estimate	$ 1,338,700	$ 168,974	$ 174,043	$ 179,264	$ 184,642	$ 190,182	$ 195,887	$ 201,764	$ 207,817	$ 214,051	$ 220,473

VOLUME PROCESSED SUMMARY	Present volume	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume processed (MBF input)	215,103	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360
Volume processed (MBF output)	204,347	25,042	25,042	25,042	25,042	25,042	25,042	25,042	25,042	25,042	25,042
Volume processed (pieces input)	5,418,882	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063

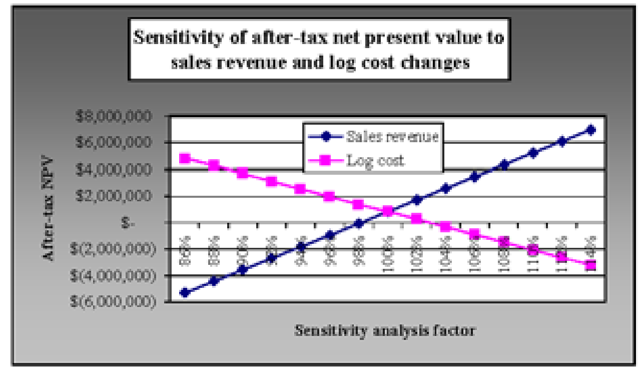
ANNUAL PRODUCTIVITY SUMMARY		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Pieces/equipment operating hour		64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0
Pieces/worker hour		22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1
Pieces/shift		2,656	2,656	2,656	2,656	2,656	2,656	2,656	2,656	2,656	2,656
Pieces/year		664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063
MBF (input)/equipment operating hour		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
MBF (input)/worker hour		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
MBF (input)/shift		105	105	105	105	105	105	105	105	105	105
MBF (input)/year		26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360

SUMMARY CASH FLOW TABLE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Discounted total	Pct of product sales
CAPITAL CASH FLOWS													
Capital costs	(2,537,199)	-	-	(5,464)	(909,411)	(3,478)	(453,740)	(218,918)	(1,974,895)	(6,524)	(4,032)	(4,832,326)	-6.6%
Contingency allowance	(761,160)	-	-	(1,639)	(272,823)	(1,043)	(136,122)	(65,675)	(592,468)	(1,957)	(1,210)	(1,449,698)	-2.0%
Salvage values		-	-	546	90,603	116	45,374	21,892	197,236	652	134	228,805	0.3%
Terminal values											1,291,640	656,924	0.9%
Net capital cash flows	$ (3,298,359)	$ -	$ -	$ (6,556)	$ (1,091,631)	$ (4,405)	$ (544,488)	$ (262,701)	$ (2,370,127)	$ (7,829)	$ 1,286,533	$ (5,396,295)	-7.4%
GROSS MARGIN													
Product sales		9,240,908	9,518,135	9,803,679	10,097,789	10,400,723	10,712,745	11,034,127	11,365,151	11,706,105	12,057,289	73,211,307	100.0%
Log costs		(6,027,469)	(6,208,293)	(6,394,542)	(6,586,378)	(6,783,969)	(6,987,488)	(7,197,113)	(7,413,026)	(7,635,417)	(7,864,479)	(47,752,761)	-65.2%
Subtotal: gross margin		$ 3,213,439	$ 3,309,842	$ 3,409,138	$ 3,511,412	$ 3,616,754	$ 3,725,257	$ 3,837,014	$ 3,952,125	$ 4,070,689	$ 4,192,809	$ 25,458,546	34.8%
PRODUCTION COSTS													
Direct production costs													
Equipment operating costs		(332,155)	(341,393)	(350,928)	(361,461)	(373,076)	(383,757)	(395,288)	(406,681)	(419,981)	(432,532)	(2,624,379)	-3.6%
Wages and worker accessories	(9,304)	(893,449)	(920,073)	(947,497)	(975,743)	(1,004,836)	(1,034,802)	(1,065,667)	(1,097,458)	(1,130,203)	(1,163,930)	(7,082,321)	-9.7%
Contingency allowance	(1,396)	(183,840)	(189,220)	(194,764)	(200,580)	(206,687)	(212,784)	(219,143)	(225,621)	(232,528)	(239,469)	(1,456,005)	-2.0%
Subtotal: direct production costs	$ (10,700)	$ (1,409,444)	$ (1,450,687)	$ (1,493,188)	$ (1,537,783)	$ (1,584,599)	$ (1,631,343)	$ (1,680,099)	$ (1,729,760)	$ (1,782,712)	$ (1,835,931)	$ (11,162,706)	-15.2%
Annual fixed & overhead costs													
Annual land lease cost	-	-	-	-	-	-	-	-	-	-	-	-	0.0%
Annual building lease cost	(2,450)	(5,277)	(5,544)	(5,824)	(6,119)	(6,428)	(6,754)	(7,095)	(7,454)	(7,832)	(8,228)	(47,941)	-0.1%
Land and buildings repairs and maintenance		(8,626)	(8,717)	(8,808)	(8,899)	(8,992)	(9,086)	(9,183)	(9,282)	(9,385)	(9,492)	(63,185)	-0.1%
Administration		(377,098)	(388,336)	(538,182)	(609,291)	(627,450)	(731,119)	(752,918)	(876,146)	(902,281)	(929,201)	(4,473,499)	-6.1%
Other costs		(12,875)	(13,261)	(13,659)	(14,069)	(14,491)	(14,926)	(15,373)	(15,835)	(16,310)	(16,799)	(102,002)	-0.1%
Insurance costs	(4,718)	(35,385)	(34,998)	(35,684)	(36,713)	(37,713)	(38,326)	(39,379)	(40,235)	(41,633)	(42,446)	(270,149)	-0.4%
Ad valorem (property) taxes	(43,707)	(60,749)	(45,011)	(35,854)	(55,310)	(39,820)	(47,828)	(45,449)	(96,693)	(68,515)	(51,562)	(419,675)	-0.6%
Contingency allowance	(5,088)	(50,001)	(49,587)	(63,801)	(73,040)	(73,489)	(84,804)	(86,940)	(104,565)	(104,596)	(105,773)	(537,645)	-0.7%
Subtotal: fixed costs and overheads	$ (55,963)	$ (550,010)	$ (545,453)	$ (701,812)	$ (803,440)	$ (808,384)	$ (932,842)	$ (956,338)	$ (1,150,210)	$ (1,150,551)	$ (1,163,499)	$ (5,914,096)	-8.1%
Operating income (loss)	$ (66,663)	$ 1,253,986	$ 1,313,702	$ 1,214,137	$ 1,170,188	$ 1,223,771	$ 1,161,072	$ 1,200,577	$ 1,072,155	$ 1,137,426	$ 1,193,378	$ 8,381,744	11.4%
Working capital cash flow		$ (577,964)	$ (17,350)	$ (11,620)	$ (15,731)	$ (18,693)	$ (15,413)	$ (19,717)	$ (15,753)	$ (20,782)	$ 713,026	$ (270,553)	-0.4%
Cash flow before finance and tax	$ (3,365,021)	$ 676,021	$ 1,296,352	$ 1,195,960	$ 62,825	$ 1,200,672	$ 601,171	$ 918,159	$ (1,313,726)	$ 1,108,815	$ 3,192,938	$ 2,714,896	3.7%
FINANCING CASH FLOWS													
New borrowing (loan principal)	1,042,490	210,169	6,309	4,226	367,345	6,798	184,713	93,261	793,358	7,557	7,784	2,184,237	3.0%
Bank financing fees	(5,192)	(1,051)	(32)	(21)	(1,837)	(34)	(924)	(466)	(3,967)	(38)	(39)	(10,901)	0.0%
Loan interest payments	(3,138)	(83,399)	(87,186)	(73,632)	(58,906)	(72,031)	(56,304)	(63,973)	(61,307)	(112,674)	(96,517)	(537,155)	-0.7%
Loan principal repayments		(162,832)	(175,741)	(188,298)	(203,278)	(203,386)	(88,858)	(126,574)	(151,275)	(209,520)	(226,753)	(1,215,084)	-1.7%
Loan principal balloon repayment											(987,494)	(502,236)	-0.7%
Subtotal: financing cash flows	$ 1,034,160	$ (37,113)	$ (256,650)	$ (257,725)	$ 103,324	$ (268,653)	$ 38,627	$ (97,752)	$ 576,809	$ (314,675)	$ (1,303,020)	$ (81,138)	-0.1%
Cash flow before tax	$ (2,330,861)	$ 638,908	$ 1,039,702	$ 938,235	$ 166,150	$ 932,019	$ 639,798	$ 820,407	$ (736,917)	$ 794,141	$ 1,889,918	$ 2,633,758	3.6%

SUMMARY CASH FLOW TABLE (continued)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Discounted total	Pct. of product sales
	Year												
Cash flow before tax (from above)	$ (2,330,861)	$ 638,908	$ 1,039,702	$ 938,235	$ 166,150	$ 932,019	$ 639,798	$ 820,407	$ (736,917)	$ 794,141	$ 1,889,918	$ 2,633,758	3.6%
Net capital cash flows (non-taxable)	3,298,359	-	-	6,556	1,091,631	4,405	544,488	262,701	2,370,127	7,829	(1,286,533)	5,396,295	7.4%
WORKING CAPITAL AND FINANCING ADJUSTMENTS (non-taxable)													
Working capital	-	577,964	17,350	11,620	15,731	18,693	15,413	19,717	15,753	20,782	(713,026)	270,553	0.4%
Loan principal	(1,042,490)	(210,169)	(6,309)	(4,226)	(367,345)	(6,798)	(184,713)	(93,261)	(793,358)	(7,557)	(7,784)	(2,184,237)	-3.0%
Loan principal repayments	-	162,832	175,741	188,298	203,278	203,386	88,858	126,574	151,275	209,520	226,753	1,215,084	1.7%
Loan principal balloon repayment	-	-	-	-	-	-	-	-	-	-	987,494	502,236	0.7%
Subtotal: net working capital and financing adjustments	$ (1,042,490)	$ 530,627	$ 186,782	$ 195,693	$ (148,335)	$ 215,281	$ (80,441)	$ 53,031	$ (626,330)	$ 222,745	$ 493,437	$ (196,364)	-0.3%
NON-CASH ADJUSTMENTS													
Depreciation expense		(863,777)	(525,605)	(322,050)	(244,784)	(516,963)	(230,941)	(323,711)	(305,843)	(916,828)	(565,998)	(3,405,260)	-4.7%
Taxable gain (loss) on salvage		-	-	(1,454)	2,603	(741)	43,189	21,892	98,191	(1,736)	(859)	98,485	0.1%
Taxable gain (loss) on terminal values											70,698	35,957	0.0%
Subtotal: non-cash adjustments	$ -	$ (863,777)	$ (525,605)	$ (323,504)	$ (242,180)	$ (517,704)	$ (187,753)	$ (301,820)	$ (207,652)	$ (918,563)	$ (496,159)	$ (3,270,819)	-4.5%
Taxable cash flow	$ (74,993)	$ 305,758	$ 700,880	$ 816,980	$ 867,265	$ 634,002	$ 916,092	$ 834,319	$ 799,228	$ 106,151	$ 600,664	$ 4,562,869	6.2%
CAPITAL GAINS TAXES													
Capital gain (loss) on land & buildings sale											135,832	69,084	0.1%
Federal capital gains tax											(20,375)	(10,363)	0.0%
State capital gains tax											(6,792)	(3,454)	0.0%
Subtotal: capital gains taxes											$ (27,166)	$ (13,817)	0.0%
INCOME TAXES													
Federal income taxes	22,273	(90,810)	(208,161)	(242,643)	(257,578)	(188,298)	(272,079)	(247,793)	(237,371)	(31,527)	(178,397)	(1,355,172)	-1.9%
State income taxes	7,499	(30,576)	(70,088)	(81,698)	(86,727)	(63,400)	(91,609)	(83,432)	(79,923)	(10,615)	(60,066)	(456,287)	-0.6%
Subtotal: income taxes	$ 29,772	$ (121,386)	$ (278,249)	$ (324,341)	$ (344,304)	$ (251,699)	$ (363,689)	$ (331,225)	$ (317,294)	$ (42,142)	$ (238,463)	$ (1,811,459)	-2.5%
After-tax cash flow	$ (2,301,089)	$ 517,522	$ 761,453	$ 613,894	$ (178,155)	$ 680,321	$ 276,110	$ 489,182	$ (1,054,211)	$ 751,999	$ 1,624,288	$ 808,482	1.1%

NPV sensitivities to sales revenue and log cost scaling factors

Sales revenue scaling factor	**Sales revenue NPV**	Log cost scaling factor	**Log cost NPV**
86%	$ (5,322,027)	86%	$ 4,824,736
88%	$ (4,446,240)	88%	$ 4,250,986
90%	$ (3,570,453)	90%	$ 3,677,235
92%	$ (2,694,666)	92%	$ 3,103,484
94%	$ (1,818,879)	94%	$ 2,529,734
96%	$ (943,092)	96%	$ 1,955,983
98%	$ (67,305)	98%	$ 1,382,232
100%	$ 808,482	100%	$ 808,482
102%	$ 1,684,269	102%	$ 234,731
104%	$ 2,560,056	104%	$ (339,020)
106%	$ 3,435,843	106%	$ (912,770)
108%	$ 4,311,630	108%	$(1,486,521)
110%	$ 5,187,417	110%	$(2,060,272)
112%	$ 6,063,204	112%	$(2,634,022)
114%	$ 6,938,990	114%	$(3,207,773)
		Mid-point =	100%
		Adjustment factor =	2%



GENERAL ASSUMPTIONS FOR BIG ONION RIVER SORT YARD FOR 2008

System 1 configuration **IMPORTANT! Assumptions in blue must be entered.**

ENTERED GENERAL ASSUMPTIONS

Interest rates

Bank deposit rate	4.00%
Bank lending rate	8.00%
Bank financing charge	0.50%
Inflation rate	3.0%
Required pre-tax premium on risk capital	10.00%

Other general assumptions

Time to construct and start up (months)	6
Ad valorem (property tax) mill rate ($/$1000)	32

Income & capital gains taxes	Income tax	Capital gains tax	Social Security	Max. taxed	Medicare	Workers' Compensation	Unemployment insurance	Max. taxed
Federal	33.0%	15.0%	6.20%	$ 90,000	1.45%		0.80%	$ 7,000
State	10.0%	5.0%				25%	3.00%	$ 14,700
Combined tax rate	39.7%							

CALCULATED GENERAL ASSUMPTIONS

Debt and equity percentages

Debt/total capital	40%
Equity/total capital	60%

Weighted average costs of capital	Nominal	Real
Before-tax WACC	11.60%	8.35%
After-tax WACC	6.99%	3.88%

SYSTEM CAPACITY

Total shift capacity

	Capacity	Check one
Either: Pieces/shift	**3,125**	X
Or: MBF/shift	**287**	

Facility full-time operation shift hours

	Operating days/year	Shift hours/ year
Shift 1	**250**	2,500
Shift 2	-	-
Shift 3	-	-
Shift 4	-	-

Standard hours/shift	**10.0**	ift hrs./year	2,500
Maximum shift hours/day	10	Shifts/year	250
		Full time operating days/year	104

Capacity Utilization	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Percent of full-time operation utilized		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Percent of total operating capacity utilized		85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Shifts/year		250	250	250	250	250	250	250	250	250	250
Shift 1		250	250	250	250	250	250	250	250	250	250
Shift 2		-	-	-	-	-	-	-	-	-	-
Shift 3		-	-	-	-	-	-	-	-	-	-
Shift 4		-	-	-	-	-	-	-	-	-	-
Pieces/year input		664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063
MBF/year input		26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360

RESOURCE SUPPLY
(International 1/4" log rule)

Piece Size Distribution (Small-end diameter - inches)	16' logs MBF/piece	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
3.0-4.9		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5.0-6.9	0.0200	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%
7.0-8.9	0.0400	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
9.0-10.9	0.0650	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
11.0-12.9	0.0950	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
13.0-14.9	0.1350	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
15.0-16.9	0.1800	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
17.0-18.9											
19.0-20.9											
21.0-22.9											
23.0-24.9											
>=25.0											
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Piece Size Distribution with Pieces Fixed (Pieces/shift)

(Small-end diameter - inches)		Year									
		2009	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
3.0-4.9		-	-	-	-	-	-	-	-	-	-
5.0-6.9		1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195	1,195
7.0-8.9		664	664	664	664	664	664	664	664	664	664
9.0-10.9		398	398	398	398	398	398	398	398	398	398
11.0-12.9		213	213	213	213	213	213	213	213	213	213
13.0-14.9		133	133	133	133	133	133	133	133	133	133
15.0-16.9		53	53	53	53	53	53	53	53	53	53
17.0-18.9		-	-	-	-	-	-	-	-	-	-
19.0-20.9		-	-	-	-	-	-	-	-	-	-
21.0-22.9		-	-	-	-	-	-	-	-	-	-
23.0-24.9		-	-	-	-	-	-	-	-	-	-
>=25.0		-	-	-	-	-	-	-	-	-	-
Total		2,656	2,656	2,656	2,656	2,656	2,656	2,656	2,656	2,656	2,656

Volume Distribution with Pieces Fixed (MBF/shift)

(Small-end diameter - inches)		Year									
		2009	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
3.0-4.9		-	-	-	-	-	-	-	-	-	-
5.0-6.9		20	20	20	20	20	20	20	20	20	20
7.0-8.9		23	23	23	23	23	23	23	23	23	23
9.0-10.9		22	22	22	22	22	22	22	22	22	22
11.0-12.9		17	17	17	17	17	17	17	17	17	17
13.0-14.9		15	15	15	15	15	15	15	15	15	15
15.0-16.9		8	8	8	8	8	8	8	8	8	8
17.0-18.9		-	-	-	-	-	-	-	-	-	-
19.0-20.9		-	-	-	-	-	-	-	-	-	-
21.0-22.9		-	-	-	-	-	-	-	-	-	-
23.0-24.9		-	-	-	-	-	-	-	-	-	-
>=25.0		-	-	-	-	-	-	-	-	-	-
Total		105	105	105	105	105	105	105	105	105	105

Piece Count Calculation
(Pieces/year)

(Small-end diameter - inches)		Year 2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
3.0-4.9		-	-	-	-	-	-	-	-	-	-
5.0-6.9		298,828	298,828	298,828	298,828	298,828	298,828	298,828	298,828	298,828	298,828
7.0-8.9		166,016	166,016	166,016	166,016	166,016	166,016	166,016	166,016	166,016	166,016
9.0-10.9		99,609	99,609	99,609	99,609	99,609	99,609	99,609	99,609	99,609	99,609
11.0-12.9		53,125	53,125	53,125	53,125	53,125	53,125	53,125	53,125	53,125	53,125
13.0-14.9		33,203	33,203	33,203	33,203	33,203	33,203	33,203	33,203	33,203	33,203
15.0-16.9		13,281	13,281	13,281	13,281	13,281	13,281	13,281	13,281	13,281	13,281
17.0-18.9		-	-	-	-	-	-	-	-	-	-
19.0-20.9		-	-	-	-	-	-	-	-	-	-
21.0-22.9		-	-	-	-	-	-	-	-	-	-
23.0-24.9		-	-	-	-	-	-	-	-	-	-
>=25.0		-	-	-	-	-	-	-	-	-	-
Total		664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063	664,063

Volume Calculation
(MBF (input)/year)

(Small-end diameter - inches)		Year 2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
3.0-4.9		-	-	-	-	-	-	-	-	-	-
5.0-6.9		5,080	5,080	5,080	5,080	5,080	5,080	5,080	5,080	5,080	5,080
7.0-8.9		5,645	5,645	5,645	5,645	5,645	5,645	5,645	5,645	5,645	5,645
9.0-10.9		5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503	5,503
11.0-12.9		4,290	4,290	4,290	4,290	4,290	4,290	4,290	4,290	4,290	4,290
13.0-14.9		3,810	3,810	3,810	3,810	3,810	3,810	3,810	3,810	3,810	3,810
15.0-16.9		2,032	2,032	2,032	2,032	2,032	2,032	2,032	2,032	2,032	2,032
17.0-18.9		-	-	-	-	-	-	-	-	-	-
19.0-20.9		-	-	-	-	-	-	-	-	-	-
21.0-22.9		-	-	-	-	-	-	-	-	-	-
23.0-24.9		-	-	-	-	-	-	-	-	-	-
>=25.0		-	-	-	-	-	-	-	-	-	-
Total		26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360	26,360

PIECE COUNT AND VOLUME COUNT CALCULATORS

(used to aid in calculating appropriate pieces/shift and volumes/shift)

(The results from the calculations below are for reference only. They are not transferred anywhere.)

		Piece count calculator (volume distribution is known)					Volume calculator (piece count distribution is known)			
(Small-end diameter - inches)	MBF/piece	Pieces/shift	Percent	MBF/shift	Percent		Pieces/shift	Percent	MBF/shift	Percent
3.0-4.9	0.0000	-	0.0%	-			-		-	0.0%
5.0-6.9	0.0200	9,168	80.8%	183	**63.2%**		1,976	**63.2%**	40	38.5%
7.0-8.9	0.0400	1,587	14.0%	63	**21.9%**		684	**21.9%**	27	26.7%
9.0-10.9	0.0650	471	4.2%	31	**10.6%**		330	**10.6%**	21	20.9%
11.0-12.9	0.0950	102	0.9%	10	**3.3%**		104	**3.3%**	10	9.6%
13.0-14.9	0.1350	18	0.2%	2	**0.9%**		27	**0.9%**	4	3.5%
15.0-16.9	0.1800	2	0.0%	0	**0.1%**		4	**0.1%**	1	0.7%
17.0-18.9	0.0000	-	0.0%	-			-		-	0.0%
19.0-20.9	0.0000	-	0.0%	-			-		-	0.0%
21.0-22.9	0.0000	-	0.0%	-			-		-	0.0%
23.0-24.9	0.0000	-	0.0%	-			-		-	0.0%
>=25.0	0.0000	-	0.0%	-			-		-	0.0%
Total	0.0256	11,348	100.0%	**290**	100.0%		**3,125**	100.0%	103	100.0%