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# Developing a Custom Portable Sawmill Enterprise



Natural Resource, Agriculture, and Engineering Service  
Cooperative Extension



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# **Developing a Custom Portable Sawmill Enterprise**

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# Introduction

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Portable sawmills have become an attractive enterprise option in recent years. With improved technology, a small unit run by one or two persons can economically produce high-quality lumber. As a sawyer, you have two options when it comes to how you want to run your business: 1) custom sawing where you never have title to the logs or lumber but you get paid immediately, or 2) lumber production where you do have title to the logs and lumber but only make money when the lumber is sold. There are more than seventy manufacturers of portable sawmills from which to choose and a wide variety of models. The simplest and least expensive models rely on manual labor for all operations except powering the saw blade. The more automated, and therefore more expensive, models include hydraulic or electric accessories that allow the operator to do a minimum of physical labor.

Interest and sales are currently very strong. One manufacturer states that his company's business is expanding at about 4 percent annually. Another indicator of interest is the development of a magazine entitled *Independent Sawmill & Woodlot Management* devoted to portable sawmills, firewood production, and associated enterprises. Subscriptions have risen by twelve thousand in just two years.

Sawmill employment has traditionally been one of the most physically strenuous and dangerous occupations. So why are people buying and operating these portable mills? Simply stated, technology has filled a market niche!

Many owner-operators have retired relatively young and are in good health. Others are people

looking to start a business after the loss of a job. There are many reasons people consider a portable sawmill business. Physical labor at a job that is production oriented may offer an enjoyable break from an office career. Most operators are sole owners with sole proprietorships, which also fosters a sense of independence. Having said this, many owner-operators of custom sawmills have emphasized that it is important for potential operators to be mechanically inclined and passionate about wood. Cutting two-by-sixes over and over can get very repetitive.

The demand for services provided by portable mills is a relatively new phenomenon. Much of the North central and Northeastern United States are heavily forested with maturing stands of mixed hardwood and softwood species. The wood resource for these smaller mills is abundant. While acreage of forest and standing volume of timber is generally increasing, ownership size and tenure is decreasing. "Large-scale" sawtimber management is just not realistic for many owners. Portable mills can fill the niche that the traditional forest industry has lost. These mills can often turn a profit from relatively small volumes of low-grade sawlogs from forest thinnings on site that otherwise would be harvested as low-value firewood or pulpwood. Owner-operators can often gain access to free or inexpensive logs, seek out specialty "character" wood, saw custom dimensions, and saw on sites with low sawtimber volumes, thereby saving trucking to and from a mill.

This guide reviews key considerations when investigating options to develop a portable sawmill

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enterprise. Because the vast majority of sales are now in the bandsaw market, and the authors' experience is largely limited to them, this book focuses mostly on bandsaws. However, much of the material covered is equally applicable to portable circular saw mills. Information is arranged in the following sections: Developing a Business Plan; Selecting and

Purchasing Your Mill; Efficient Production; Business Considerations; Safety; Insurance and Liability; and Financial Analysis. Four appendices provide supplemental materials that will be useful. They include information references, sources of assistance, a list of portable sawmill manufacturers, a sample contract, and a glossary.



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# Developing a Business Plan

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It's hard to overstate the importance of a good business plan. It is your road map to success. A plan will allow you to focus your limited time and resources on endeavors with a high likelihood of success. Indeed, loans from any finance institution are contingent upon an approved business plan; therefore, the time spent on the development of a business plan is critical.

Committing time to a business means less time for other family activities. It is a good idea to sit with your family members and consider your goals, those of each family member, and make sure everyone is on board with your decision to start the enterprise. You may have expectations of help other family members will provide, and this needs to be clear. Otherwise, after investing considerable time and money, you may find your business is conflicting with other family priorities. The publications *Forest Landowner's Guide to Evaluating and Choosing a Natural Resource-Based Enterprise* and *Natural Resource Income Opportunities for Private Lands* by

J.S. Kays et al. (included in the references listed in appendix A) cover many critical aspects of developing a business plan.

A good business plan provides some milestones by which to measure the relative success of your business. Timely adjustments are inevitable even with the best of plans. The old adage "learn to work smarter, not harder" may be especially relevant in the saw-mill business because you can very quickly be overwhelmed by strenuous physical labor and long hours

in an effort to realize a profit. It may be a good idea to assess your interests and capabilities by hiring on with an established owner-operator for a few weeks or months. You'll learn about the realities of running both a mill and a business. You'll also get an appreciation of your physical limitations and be better able to decide on how much automation is appropriate for your enterprise. The key is to optimize your labor efficiency and maximize your profit margin! The remainder of this publication deals with the various components that will allow you to do so.

## What's in a business plan?

As an example of the components that go into a business plan, a pamphlet published by S.C.O.R.E. entitled "How to Really Start Your Own Small Business" contains the following sections:

1. The idea
2. Testing the idea
3. Protecting the idea
4. The right people
5. Structuring the business
6. Cash flow
7. Finding money
8. Technology for your business
9. The best business plan for you
10. The Internet
11. Starting on the right foot
12. Looking ahead

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## ORGANIZING YOUR BUSINESS

How you structure your business can have a significant impact on both your potential liability and your taxes. The forms of ownership and a brief description are provided.

### *Sole proprietorship*

The reason that a substantial number of businesses use the proprietorship form is the simple nature of the organization. Every aspect of the business revolves around the owner, who makes all the decisions. The owner decides when the business is formed, how it operates, and when it chooses to end its existence. This also means all of the assets, profits, debts, and liability are the responsibility of the owner alone. This form of organization is well adapted to owners of sawmills who have part-time or small operations. Setting up such a proprietorship does

require legal documents, and sole proprietors should have adequate liability insurance to protect assets.

### *Partnership*

This is an association of two or more persons making business decisions as co-owners. The partners share all of the assets, profits, debts, and liability. By combining resources and sharing responsibilities, the partners gain the advantage of a larger operation; this lowers costs, increases efficiencies, and enables the partners to increase business volume through their combined efforts. Partnerships are of two common types, general and limited partnerships, with limited partners having only a limited role in the operation and decision-making. In a third type of partnership, the registered limited liability partnership, the partners are not liable for the debts and obligations of the partnership arising from acts of another partner.

### Where can I find help with developing a business plan?

- The best place to start is at your local public or community college library. These libraries often have a collection of books, pamphlets, and references that will give you a good idea of how to develop a business plan and where to go to find more help.
- A phone call to your local Chamber of Commerce or economic development office is another good idea. They also have publications and can put you in touch with economic development specialists and a representative from S.C.O.R.E. (Senior Corps of Retired Executives) who can work with you on a one-to-one basis.
- The United States Small Business Administration is a great source of information and technical assistance. They are reachable by calling 1-800-827-5722 or logging onto their Web site at [www.SBAONLINE.SBA.GOV/](http://www.SBAONLINE.SBA.GOV/). They, too, can link you up with S.C.O.R.E.
- The yellow pages of your local phone book probably list many business support services available locally; some at no cost.
- Also look in the white pages of your local phone book for a toll-free number for the national Small Business Information Center, who can (for a nominal fee) provide publications and technical assistance on every aspect of starting and running a small business.
- Financial institutions such as banks and credit unions often provide references and occasionally sponsor seminars on enterprise development.
- County Cooperative Extension offices and local economic development offices may conduct seminars and workshops on the topic.

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An important condition is the requirement of the partnership to carry minimum liability insurance. The organization of any of these different forms of partnership should include legal counsel and the development of a legal agreement in writing.

### *Corporations*

This is a legal entity that has a life of its own that is separate and apart from the lives of people who own or operate the corporation. Formation requires filing legal documents, the central document being the Articles of Incorporation. This type of organization has more appeal and advantage to medium and large businesses than to small businesses. Corporations do offer some liability protection.

### *Limited Liability Company*

LLCs are designed to allow business owners to gain the advantage of limited liability for debts and expenses, which corporations provide, while being treated as a partnership for most other operational purposes.

Before deciding to organize a partnership or corporation, two important questions must be answered. The first asks, "Is the business financially strong enough to generate income to support two owners and their financial expectations?" The second is equally important, "Can I get along and work well with the person I want to bring into the business?" Before deciding on which type of business organization to choose, business owners should seek legal counsel to understand the advantages

and disadvantages of each and how it will affect the management, operation, and tax considerations of their business.

Detailed information on the components of a business plan is readily available through publications. Make the contacts listed on page 4 and seek out counsel. Judicious time spent at the planning stage will pay off greatly once your business is up and running!

Taxes (income, self-employment, employment, and sales) are an important consideration when starting and running a business. Internal Revenue Service (I.R.S.) Publication 583, "Starting a Business and Keeping Records," contains useful information including where to go for help, what new business owners need to know, forms of businesses, identification numbers, establishing a tax year, accounting method, business taxes, depositing taxes, information returns, penalties, business expenses, and recordkeeping. I.R.S. Publication 583 is included in a set of forms and publications entitled "Your Business Tax Kit" which can be obtained by calling 1-800-829-3676. The I.R.S. also partners with local organizations to sponsor free or low-cost workshops and courses on the above topics. To learn more about such opportunities, call your local I.R.S. office or log onto the IRS Web site at [www.irs.gov](http://www.irs.gov). On the Web site, type "workshops" into the search block and click on "Search." This leads to a list of workshops by state and topic.

The specifics regarding state and local sales taxes vary widely. Start with your local Chamber of Commerce to track down that information.

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# Selecting and Purchasing Your Mill

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Prospective buyers should not rush into a purchase. With over thirty companies manufacturing and selling portable mills in the U.S. and Canada, several types of mills, and the wide range of options and features available, it will be helpful to gain firsthand familiarity with as many specific mills as possible before making a purchase. Still, the best way to start is by acquiring manufacturers' brochures and other promotional pieces such as videos and by visiting their Web sites. The listing in appendix B provides information on how to contact manufacturers. The magazine *Independent Sawmill & Woodlot Management* (see appendix A), is an excellent source of information on various mills. Nearly all popular makes and models are advertised in the magazine, and it regularly does equipment reviews for specific mills and contains articles on various aspects of owning and operating a portable sawmill business. Look in the publication reference section of appendix A for other references. Remember that new information is constantly being made available, so look for it.

Start by roughly categorizing the range of mills by new purchase price. Price should correlate with mill quality and production capacity. Consider how you can get the most out of the money you have available for purchase. If, for instance, you have only about \$10,000 budgeted for a mill, you could afford a new mill on the low production end, a used mill in good condition from the middle range, or a fixer-upper from the upper end. There are enough mills in most locales to make purchasing a used mill a viable option. Depending on your circumstances and mechanical abilities, you might consider learning

about and eventually looking at mills that may seem initially out of your price range. Learn about enough different mills so that you can determine what is best for your needs and interests. Then get familiar with those models.

One of the first decisions you will be faced with is whether to buy a circular saw mill or a bandsaw mill. The purchase price of circular mills tends to be higher, but production is typically about double that of a bandsaw mill. Bandsaws are currently outselling circular saws, but there are many very satisfied owner-operators of both types.

## **Bandsaw or circular saw mill?**

Advantages of band mills include:

- Small saw kerf (width of cut with each pass of the blade) of about  $\frac{3}{32}$  inch compared to  $\frac{1}{4}$  inch for the circular blade. If sawing one-inch lumber, the bandsaw will produce 20 to 25 percent more lumber out of each log.
- Produce boards with smoother surfaces. (With proper band maintenance.)
- They have relatively inexpensive saw blades.

Disadvantages of band mills include:

- Band mills are more temperamental than circular mills.
- Band mills require more maintenance.



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Most new portable mills range in price from around \$5,000 to \$35,000. New manual mills (you load the logs and push the band-saw through the log) run about \$5,000 to \$12,000, while fully hydraulic mills (load and turn logs, powered carriage-feed drive) cost about \$16,000 to \$35,000. Production for the manual mills is only about 1,000 board feet per eight-hour day, while hydraulic mills may cut 3,000 board feet per day. Commercial mills for professionals may cost from \$40,000 to \$100,000 and produce 5,000 to 10,000 board feet daily. Power sources include gasoline, electric, or diesel, from 8 to 50 horsepower. Some saws can be driven with a power takeoff (PTO) from a farm tractor.

As the prices indicate, there are a wide range of options and features from which to choose. Even some of the bare-bones manual mills can be upgraded to include log loaders and turners, debarkers, hydraulic blade tensioners, and moving operator seats. Maximum log sizes range from eighteen- to thirty-six-inch diameters and sixteen- to twenty-foot lengths. With modification, longer lengths can be accommodated. In fact, many mills have found a niche market for sawing long timbers of twenty feet and more for specialty applications.

Some manufacturers sell their mills as stationary units without the trailer package for buyers who are not interested in a portable feature. Are you going to custom-saw at a base site or be a portable operation going to various sites? This decision will influence whether or not you'll need the trailer package. These mills pull very easily and can be set up quickly on reasonably level ground. The ability to bring the mill to the site is a major appeal to most customers. The trailer package may also be a worthwhile investment at a stationary operation, as it will allow for easy



*When you buy a mill, you'll have to decide whether to get the trailer package. The ability to bring the mill to the site is a major appeal to many customers.*

cleanup of sawdust and changing setup as the operation grows.

In both stationary mills and some portable models, the mill bed can be set low to the ground to ease loading of the logs. However, many manufacturers set the bed of their mills at about waist height, so you must get the log onto the mill at that height. This can be accomplished in a variety of ways. Hydraulic loader attachments allow the log to be rolled onto a rotating pivot arm that raises the log. Manual mills may be equipped with a hand winch, similar to those found on boat trailers, that allows the log to be rolled up two metal skids onto the mill bed. A tractor front-end loader or forklift works well also. Another option is to use a frame boom on a three-point hitch of a tractor equipped with a chain and a pair of log tongs to lift logs. By positioning the mill on a slope it is sometimes possible just to roll the logs onto the bed. If the mill bed is low, then the off-bearer must bend over to handle every sawn piece of lumber or slab. If the bed is higher, removing sawn material is easier. As with all of the feature options, the mill owner needs to determine which type of mill suits his or her particular needs or limitations, and each feature—or



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lack thereof—should be evaluated on its effect on the production rate.

Another consideration is access to parts and service. If you're mechanically inclined, having parts shipped may be adequate. On the other hand, being reasonably close to a dealer may allow you to take advantage of warranty and trained mechanical assistance. Most mills appear to be relatively simple and dependable, so maintenance and repair should not be a major problem, but lost time in any business can be frustrating and expensive.

Once you've narrowed your choice down to a few

models and/or manufacturers, visit both the dealership and individuals who have operating mills to get firsthand experience and impressions. Dealers should be able to suggest operators for you to visit. If at all practical, don't buy a specific model until you see it being used by a satisfied, competent, and experienced private owner-operator. Such a visit and an accompanying frank and candid discussion should ultimately be the primary basis for your decision as to what mill to buy. Additionally, equipment expositions offer an opportunity to see various mills in action in one location.

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# Efficient Production

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## THE PRODUCT

The way logs are cut and the need to grade lumber produced will depend upon the customer and where the lumber will be marketed. Many portable sawmill operations do not grade the lumber sawn because it was sawn on-site for a customer. However, sorting of high-grade and low-grade lumber is commonly done.

In general, hardwood lumber can be sawn for one of two purposes. *Dimension lumber* is sawn to a specific size (for example, 2"×4"×8') for building purposes. The appearance of the wood with regard to knots and other defects is less important so long as it does not affect the structural integrity of the board. *Graded lumber* is graded on its appearance, to suit the requirements of the furniture industry.

Most softwood is graded on its ability to withstand stress, mainly for the construction industry, though some is graded for its appearance in secondary manufacturing for trim, siding, flooring, and steps.

If you are planning on selling lumber to lumberyards, lumber brokers,

furniture companies, etc., you must learn at least the basics of grading timber. More importantly, this knowledge will help you when sawing to efficiently produce quality lumber for a variety of customer needs. Most of the hardwood lumber purchased in North America for remanufacture into other products is graded according to the *Rules for the Measurement and Inspection of Hardwood and Cypress* published by the National Hardwood Lumber Association (NHLA). The NHLA grades for hardwood

lumber can be complicated, but a basic understanding of these principles by the sawmill owner can be invaluable. You may also access extension publications on this topic or contact the National Hardwood Lumber Association for an inspection-training manual or to learn about training courses they provide, or for other useful information on hardwood grading (see appendix A).

It is important to understand that the log from the bottom of a tree, the butt log, has the greatest potential to produce FAS-quality boards. This is because a tree has the greatest amount of heartwood in the butt log

### Hardwood grades

When grading hardwoods, the best lumber is clear, free of knots and other defects. The basic grades and their minimum size requirements are outlined below:

- Firsts and Seconds (FAS): six inches and wider, eight feet and longer
- Select: four inches and wider, six feet and longer
- No. 1 Common: three inches and wider, four feet and longer
- No. 2 and No. 3 Common: lower grades that usually account for most of the production

For each category, there are criteria for the amount of wood free of defects, which include knots and other features. FAS grade is the top grade and thus brings the highest price.

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and the knots caused by past branches have long since healed over. The center part of most logs—which is where these old knots are located—is used for lower-grade products such as ties and posts. The best quality lumber is taken from the outer portion of the tree, and the butt logs tend to have clearer wood compared to smaller diameter logs from upper portions of the tree.

The location and size of past branches is important because they result in knots, which are considered a defect when grading lumber. The important point to remember is that if your customer is interested in producing quality boards it would be good to separate the butt logs from the lower-quality logs. This will make it easier to sort the boards as they are sawn

## THE PROCESS

There are many tricks of the trade, and truly the best way of learning is by doing. Sawing is both an art and a science and there is a lot to learn from both experience and study. Several of the portable sawmill manufacturers publish how-to guides that

do a good job of introducing the sawing process. More specific techniques are often featured in books and magazines on the subject; several are listed in appendix A. Once you have an idea of the process, visit some owner-operators to watch their techniques. A few considerations in operating a portable mill follow:

- One proclaimed advantage of bandsaw mills is increased lumber yield from logs due to smaller saw kerf. This claim holds true as long as the blades are kept sharp and lumber is sawn accurately. If the blade wanders due to dullness or, as in the case of pine, the knots are harder than the surrounding wood, one must saw thicker lumber to allow the planer to true up the size.
- It is often possible to saw narrow, short, clear (free of knots) boards from the outside of a log, but it may not be worth the time needed to produce them.
- Boards with wane (bark on the edge) can be stacked on edge and gang-resawn (stacked together on the carriage) to produce square-edged

### Types of sawing

*Stress-relief sawing:* Sawlogs often have tension wood that results from stresses due to the tree growing on the side of a hill, being exposed to wind, or leaning towards an opening in the forest canopy. These stresses need to be reduced equally during sawing to minimize bowing, twisting, and/or cupping as they dry. The most common method of relieving stress is to turn the log often as it is being sawn. Another method, which is faster, is to cut the log into oversized cants to relieve most of the stress. The cants are then trimmed on each side to remove the bow effect before any boards are cut from the cants.

*Grade sawing:* The objective when sawing for grade is to maximize the amount of high-quality, knot-free lumber. Once the cant is produced, it is rotated frequently during sawing so that only one or two boards are removed from one side at one time. The technique is somewhat similar to the first method of stress relief sawing, but the log is usually turned 90 degrees, not 180 degrees.

*Quartersawing:* This is a time-consuming, but potentially cost-effective, sawing technique to cut valuable hardwood into high-grade lumber, mainly for furniture. The log is not slabbed to produce a cant but instead is cut into quarters, which are milled into lumber having the annual growth rings at not less than 45 degrees to the face of the boards. If the angle is between 80 and 100 degrees, the board is termed *fully* quartersawn. Quartersawn lumber is the most stable form of lumber, the least likely to warp during drying.

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lumber. One can maximize lumber yield by selecting boards of approximately the same width when stacking for resawing, or by removing individual boards as they become square-edged. This is especially useful when quartering the log and flipping the cant to produce quartersawn lumber.

- Quartersawn lumber is cut along the radius, rather than the tangent of the log. These boards are the least susceptible to warping because the grain pattern is relatively short and straight. Quartersawn lumber is more valuable for cabinetry but also produces narrower boards and is less efficient to saw.
- Another production booster when sawing two-by-sixes is to saw a cant (say 18"×18"), splitting it into equal parts (6"×18"), setting them on edge and gang-ripping them into the desired dimension (2"×6"); thereby producing two, three or more pieces in a single pass.
- When sawing for grade, the operator can roll the log or cant to saw the best face (least number of defects) as progression is made. Whether seeking grade or specific character, the operator can visually inspect the cut face and determine when to change faces.
- Many experienced sawyers recommend attending a short course in lumber grading for hardwood sponsored by the National Hardwood Lumber Association ([www.natlhardwood.org](http://www.natlhardwood.org)). A sawyer must know the difference between cherry pallet wood worth twenty cents per board foot and cabinet grade wood worth five dollars per board foot.

Experience is the best teacher. Operators may quickly learn log structure and recognize desirable features, such as feather-crotch, curly, or bird's-eye grain patterns. In some cases, one might decide to saw a log through and through, by not rolling the log or cant at all and just sawing off boards along the same plane. This is a sawing method often used in Europe. It produces lumber that can be book

matched for repetitive grain patterns often used in door or wall paneling, or interesting table patterns.

As owner-operator of the mill, your time is best spent sawing lumber, not loading logs or off-loading and stacking lumber. Production will be much higher with you at the controls, plus you can run the mill for longer stretches if you're not doing a lot of backbreaking labor. For these reasons, you might consider hiring a laborer or requiring that the customer supply labor for such tasks. Of course, the price of finding and keeping a good worker often comes at a premium. Then there are the liability and production considerations of depending on a novice and unknown customer-helper. Once again, experience is the best teacher.

## *Maintenance*

Adequate maintenance is the key to efficient production of quality product. Delayed maintenance is just asking for trouble on the job site. Downtime on the job brings production to a standstill and reflects poorly on your business. The time and place to do maintenance or fix a problem is in your shop or yard, not at a customer's. Adherence to lubrication and other maintenance schedules should give the owner of good equipment many years of satisfactory operation. Additionally, it's wise to keep replacement parts such as bearings, belts, and bolts on hand for quick fixes so that you don't have to wait for parts to be ordered.

The most important aspects of sawing accurate lumber with bandsaw mills are blade maintenance and mill alignment. Mill alignment controls the attitude of the blade in relation to the log and must be checked on a regular basis as outlined in the owner's manual. A sharp blade held at the proper tension will cut very accurate lumber. A poorly tensioned or dull blade will not, regardless of feed rate or power. Older sharpening grinders only ground the face of the teeth. Newer ones grind the whole tooth profile. There are handheld pliers-type setting tools and there are bench-mounted, dial-gauged setting tools. Learning to set and sharpen blades takes patience

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and practice. Some manufacturers offer sharpening services. It may be possible to touch up a blade once or twice before returning it for a professional sharpening, which may cost about half the cost of a new blade. To take advantage of professional resharpener programs requires having an adequate supply of blades on hand. One program requires a shipment of twenty blades; which means you should maintain an inventory of about fifty blades for a part-time operation. Some owner-operators don't even bother with resharpener blades and instead opt to use new blades when the others dull.

Blades need lubrication while cutting. Some operators use a water drip and may add antifreeze in the winter to prevent freezing. Many operators also find it useful to add dish soap or windshield washer fluid to reduce buildup of pitch on the blade. Others spray the blade with a kerosene and chainsaw bar oil mixture. A sharp, cool, lubricated blade will even cut black locust with ease; however, if a blade hits dirt, stone, or hardware, it needs to be changed immediately. Usually, upon dulling, the blade will try to climb out of the log or cant, or dive deeper, making the operator aware of the problem. Most manufacturers recommend resharpener the blade after two to three hours of use to prevent premature breakage.

### *Backyard Trees and Foreign Objects*

Sawing yard trees is a unique market niche, but a drawback is the increased likelihood of encountering foreign objects in the logs. A broken blade usually costs around twenty dollars, so the risk is cheaper than with traditional sawmills. One way to protect your profit margin when cutting yard trees on a contractual basis is to stipulate that the client is financially accountable for blade damage due to hardware. Use of a metal detector may also reduce the frequency of dulled or broken blades. (Plus metal detectors can be used to find dropped bolts and wrenches in sawdust.)

A blade may cut right through a large spike, but also may very well break if it hits wire. The offending piece of hardware can often be removed by chopping around it with an axe or chisel and pulling it with pliers or prying with a wrecking bar.

Dirty logs can be debarked, or the side of the log that is on the leading edge of the blade can be chopped clean with an axe or scraped away using a chainsaw with an old chain. Removing dirt and stones from that portion of the log will help prolong blade sharpness. Several mill models have the option of a debarking device that chips out a small furrow in front of the blade. Woods with silica or other minerals in the wood itself can also dull blades.

### *Sorting and Stacking Lumber*

The sorting of lumber around the portable mill is often difficult because of limited room and the lack of conveyors to move the lumber. Most operators who saw on-site either pile the lumber onto a farm-tractor wagon or onto the back of a truck. Each day's production can then be transported to an appropriate location to be stacked for air-drying. If it is piled on the ground, be careful to consider how the pile may hinder movement later when most of the wood is sawn.

It is possible to rough-sort the material after it is cut to reduce later effort in sorting. For example, high-grade (furniture market) and low-grade lumber (pallet market) can be put in different piles, or wide boards can be separated from narrow boards. The number of sorts will usually be determined by the needs of the customer.

For sawmill owners who want to use a simple method for sorting lumber of one species into various classes, it is suggested that boards without knots be placed in one pile, those with one knot in another pile, those with two knots in a third pile, with three knots in a fourth, and more than three knots in a fifth pile. This type of sorting by grade will separate high-value lumber from the middle- and low-value lumber.



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# Business Considerations

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The key to establishing and running a profitable business (any business) is finding your niche. From a business perspective, niche refers to being able to do something better than your competition. That “something better” for you as a sawyer might involve supplying a unique service, product, or value, or some combination thereof.

Some of the services that portable sawmills can provide, stationary mills cannot. For instance, a mill that travels to the logging site saves the customer the direct cost of and time needed for transporting logs and lumber, an operation that most people are unable to accomplish on their own, anyway. Portable mills can also provide an on-site, custom sawing service, giving the customer the ability to specify precisely what dimension lumber he or she wants out of each log. And portable mills can profitably saw many logs, or flitches, that cannot be handled on other mills (i.e., short logs, short crooked logs, shingle bolts or even tapered timber).

Unique products might be book-matched black cherry lumber for wainscoting, or crotchwood from butternut for coffee tables. A unique value for some customers is being able to have a portable

sawmill work at a remote site, sawing lumber from a pine plantation for construction of a vacation cabin, for example. The use of on-site logs eliminates the need to truck in outside logs and lumber. This saves the customer time and money and adds nostalgic value—and there’s your niche!

A bit of sage advice shared by experienced owner-operators is, “*Don’t expect to be able to outcompete prices offered by retail lumber dealers.*” If you are to stay in business and make a profit, you must be able to offer something that your competition (retailers or other portable sawmill owners) can’t. Find your



*Specialty cuts such as the burl on the left and book-matched black cherry pieces on the right may be cut from a log not useful for traditional dimension lumber.*

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niche. Your service (availability, custom sawing, low prices, production rate, production efficiency, etc.) or product (species, kiln-dried, finished lumber, etc.) must be unique. It's important that you research how you can beat the competition and then capture and hold on to that market. Of course, over time it may be necessary or desirable to shift your services to adjust to changes in log availability, markets, or your interests and abilities.

Some other unique characteristics that may make your business profitable fall in the category of "customer relations." In a sense, this is a retail business since you deal directly with the customer. To satisfy your client and encourage recommendation to others (word-of-mouth), you must be courteous, helpful, flexible, understanding, dependable, prompt, and willing to work with your customers to provide the service and product they expect. Having said this, we recommend that sawyers keep up-to-date on sawing techniques, identification of woods and their use, tools, etc. Make an effort to become and stay educated. Customers will expect the sawyer to be the "expert." A sawyer who doesn't know or who gives bad information will soon be found out.

You will need to determine how you are going to charge for your services. Some operators charge by the hour, while others charge on the basis of production. It is wise to have a charge schedule for both methods and use the method to fit the specific situation. If you charge based on production, remember that cutting small, defective logs is not as time-efficient as cutting large logs, and that cutting large dimension stock is faster than cutting small or thin stock. A client paying by the hour soon recognizes that cutting those six-inch-diameter, four-foot-long logs is not practical. When paying on an hourly basis, a client will often volunteer to serve as off-bearer to save time and make the operator's job easier and faster.

When the specifics of a job are decided, it is important to develop a legally binding contract that spells out the details of cutting location, time to complete the work, charges, payments, and other

details. Be sure your contract covers liability concerns if clients will be working with you. Appendix C provides a sample contract that can be adapted by operators for a variety of situations.

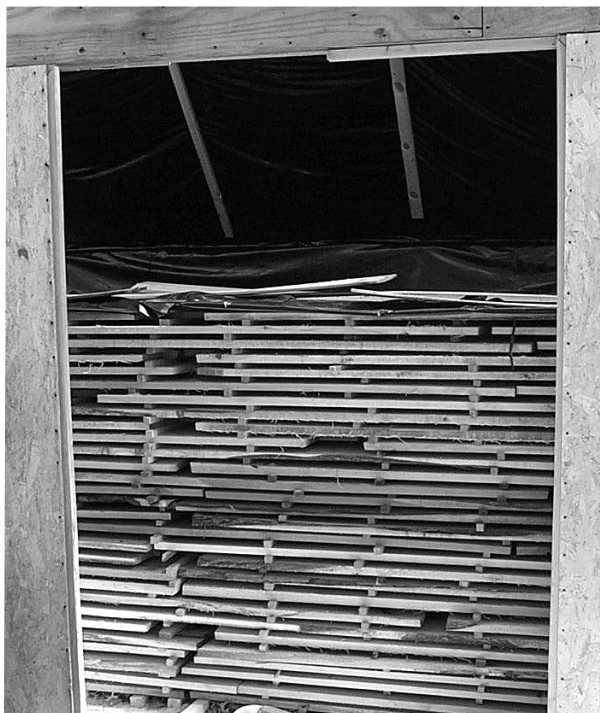
## PRODUCT AND SERVICE DIVERSIFICATION

Many owner-operators find they can enhance their profitability by expanding their services or product line. For example, many mills can be used to provide raw material for value-added enterprises such as kiln-drying, craft manufacturing, cabinet-making, or other woodworking enterprises. The operator may wish to work with some clients to exchange some services for cut boards that can be taken to their shop and dried or used for value-added manufacture. Kiln-drying is a very compatible enterprise. Lumber can be air-dried; but many wood products cannot be sold without being kiln-dried, so the serious businessperson will want to investigate

### Vertically integrate your business . . .

Additional products and/or services that you might offer your clients include:

- logging services
- kiln-dried lumber
- finished/planed lumber
- tongue-and-groove siding
- flooring
- cabin logs
- carpentry
- cabinetry
- trucking or delivery
- molding for finished carpentry
- package deals for special projects such as garages, sheds, or decks from the lumber you saw



*Lumber can be air-dried to about 20% moisture content, or 12–15% if covered. This is fine for structural lumber but not for lumber to be used in furniture or other products destined for indoors. Kiln-drying reduces turnaround time. A number of homemade solar kiln designs are available as well as solar and electric commercial units.*

solar or electric kilns to reduce turnaround time and maintain product quality. There are many models, alternative energy sources, sizes, and other variables from which to choose. These include homemade solar kilns to commercial-capacity industrial kilns. A dry place to store kiln-dried lumber should be available before a kiln is purchased or built. It is wasteful to dry lumber and then store it outside, or even in an open shed where it will pick up moisture. Kiln-dried lumber should not be stored with green lumber because insects in air-dried lumber and sawdust can reinfect sterilized (kiln-dried) lumber.

But do give careful consideration before undertaking such diversification. If you are making payments on a \$20,000 sawmill, the best way to pay off the debt is probably to increase production with that

piece of machinery, which means either work more or work more efficiently. All other sideline activities should only be pursued after you have optimized your sawmilling options. Plus, these other activities are specialized businesses that have unique safety, liability, financial, and marketing concerns possibly unfamiliar to you, or which you may be incapable of handling.

## MARKETING

Interestingly, most of the established owner-operators we spoke with didn't feel the need to market or advertise their businesses. They had all the business they wanted just from word-of-mouth. Still, for operators just starting out, or in more competitive markets, it is wise to spend some time and effort on mounting a marketing campaign. Once again, it's important to have defined your niche. What unique services can you supply to what customers? Once you've decided that, how can you most easily notify potential customers of your business?

Some places to advertise include the yellow pages, hardware stores, tree nurseries, real estate offices, penny-saver papers, farmer newsletters and magazines, and forest owner magazines. Let

### Developing leads

One aspect related to marketing is letting key individuals know of your interest in obtaining logs or access to logs. Free logs or logs at reduced cost can give you a big pricing advantage when it comes to selling retail lumber. Some potential sources of logs include loggers, firewood dealers, large sawmills (which often discard logs with metal hardware), foresters, highway departments, tree surgeons, large estates, public or governmental land managers (such as schools and 4-H camps), land developers, construction (building and earthmoving) firms, fencing contractors, and maple syrup producers.



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foresters, loggers, plumbers, electricians, carpenters, appliance repairmen, cooperative extension offices, chainsaw dealerships, farm equipment dealers and servicers, and even other sawyers know of your business. Create a Web page for your business. Look for opportunities to demonstrate your mill and your services at trade shows, forestry workshops, dealerships, and county, agricultural, and forestry fairs. Post a sign at sites where you are sawing so passersby can get in touch with you if they are interested in your services.



*Kiln-dried lumber can be marketed to cabinetmakers, crafters, and hobbyists through a number of marketing methods.*

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# Safety

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According to labor statistics, sawmilling is one of the most dangerous occupations involving strenuous labor. Injuries can happen at any time and may be severe due to the powerful moving machinery, sharp saws and blades, heavy and unstable logs, and the monotony of strenuous labor involved. It is crucial that you and your coworkers adopt safe work habits, and be prepared with first-aid supplies and training.

The Occupational Safety and Health Administration (OSHA) has regulations that apply to sawmilling. If you hire workers, make them aware of OSHA requirements that affect them. Failure to follow the OSHA regulations could mean losing any lawsuits that might be brought against you (see [www.OSHA.GOV](http://www.OSHA.GOV)).

All portable mill manufacturers' owner's manuals stress the importance of safety. If you don't have an operating manual for your machine,

acquire one from a dealer or the factory. Operating suggestions are good advice that will save you time, money, and perhaps your health.

Learn how to lift safely. Use a safety helmet that has a face shield and earmuffs. Ear protection will protect your long-term hearing and improve your endurance and productivity.

Sawmill operators should be concerned about the health problems posed by fine sawdust. Sawdust constantly getting in your eyes is a misery that may cause you to miss seeing other dangerous situations or may lessen your focus on sawing quality lumber. Many operators wear full face masks or purposely switch the position of the mill to avoid having the wind blow sawdust in their faces. Sawing dry hardwood logs (cut more than a year ago) produces the worst sawdust conditions. On a calm day, the sawdust "hangs" in the air. Some operators report

## Think safety: think ahead

It's clear that sharp blades, powerful moving machinery, and heavy logs can pose risks for anyone in the vicinity of a sawmill operation. Other, less obvious, risk factors include:

- sawdust (breathing; also may block vision)
- wood sap and dust (allergic reactions)
- vibration (circulatory or nerve problems; also may cause heavy machinery to move)
- noise (hearing loss; also distraction)
- insufficient light

Just a few ways to lessen your risks:

- get proper training for yourself (and anyone who will work around your equipment)
- set up at each worksite with utmost care
- keep equipment and work areas clean and well maintained
- wear and/or provide appropriate personal protective equipment (safety helmet, etc.)

Plan to have on hand at every work site:

- a fire extinguisher
- a first-aid kit
- a telephone (or equivalent device)
- a means of transportation to medical facilities, in case of emergency



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greater problems with sawdust from certain species and the development of allergic reactions over time.

Compare the sawmills in regard to their potential health hazards, taking into consideration the location and position of the sawdust exit chute. With some mills, the operator normally walks beside the saw, near the sawdust and engine exhaust exit points. Some mills force the sawdust to exit downwards towards the feet of the operator, but this has not totally eliminated the sawdust problem. Other mills position their sawdust exit chute in a way that poses less of a problem. However, all sawmills still pose the inherent problem of sawdust remaining on the sawn surface since this is easily blown about by the wind. Persons affected by lung ailments such as asthma should consider a sawmill with remote controls to minimize their exposure.

Owner's manuals point out the location and upkeep of all shields, warning labels, and other devices designed to reduce the risk of injury. Protective devices may seem a nuisance, but they are there for a good reason. Removal of or tampering with factory-installed safety devices will negate the manufacturer's liability should you or others be injured.

As the philosopher Dirty Harry once said, "A man must know his limitations." The same goes for sawmill operators. If you are tired, heat-stressed, or even just out of sorts, take time off or work at some

task that won't put your health or your coworkers' in jeopardy. A good rule of thumb for all businesses when production doesn't seem adequate is to work smarter, not harder. Working too fast for site conditions or your ability can lead to accidents. Don't wear baggy clothing that can get caught in saws or gears. Stay nourished and drink plenty of liquids, even on cold days. Also, take advantage of the shade of trees during the warmer months. Take regular breaks to relax, check equipment, and break up the monotony of repetitive tasks. Taking shortcuts or risks will often lead to an accident. Remember, there may be no tomorrows on the job if you or a coworker are severely injured.

Be prepared for the worst, just in case. Take a basic first-aid course that will allow you to react quickly and correctly to a health emergency. This obviously requires that you have a decent first-aid kit nearby. Heart attacks and strokes are relatively common among older men as they engage in strenuous work. Dismemberment is always a possibility where saws and blades are used. Know how to stop bleeding and what to do with a detached finger or limb. Don't work alone in isolated conditions. Let someone know where you are and what time you expect to return. A cell phone can be a life-saver in emergency situations.

Don't view safe work habits and equipment as an unnecessary bother; instead view them as your ticket to continued health and business prosperity.

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# Insurance and Liability

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A critically important aspect of your business is that of liability and insurance. Many owner-operators overlook or consciously ignore this unpleasant and seemingly expensive undertaking. Unfortunately, as the old saying goes, “you can pay me now, or you can pay me later.” The peace of mind that a sound insurance policy buys, or business practices that reduce liability, truly are worth the costs. Being up front regarding insurance may actually help you get jobs where clients want to see insurance certification. Surely no owner who ever had an accident or lost a claim leveled against him or her ever said, “Boy, I sure wish I hadn’t bothered with insurance!” Plus, it’s wise for owners to have accident and injury insurance on themselves because worker compensation doesn’t usually cover the owner of a sole proprietorship.

*As the old saying goes,  
“you can pay me now, or  
you can pay me later.”*

## WORKER COMPENSATION (WC)

This insurance covers medical expenses and/or lost wages for your employees should they become injured while on the job. Rates can be substantial for this insurance, perhaps half of a worker’s wages if the insurance is carried through the state insurance fund. Rates may be substantially reduced if you and your employees participate in safety training offered through an industry-group insurance cooperative. Contact your state’s forest-industry lobby representative or worker compensation board to learn more about such opportunities. Self-employed individuals

do not have to obtain WC insurance in many states. They may, however, purchase WC through a private insurance firm as part of their overall business-insurance package. Indeed, many clients may request evidence of a WC policy before they allow work to begin. It is difficult to say with certainty how the employee/employer and sawyer/client relationships

might be interpreted should an accident occur, but the safest way is for you, the owner-operator to carry your own WC policy.

Your employees may be entitled by law to WC, in which case it would be impossible for them to “sign away” that right. Even if they attempted to do so, their survivors or dependents wouldn’t be signing such a document! There are substantial penalties for negating your WC obligations, whether or not a claim is ever filed. Disability benefits (compensation for wages missed as a result of an injury that occurs to them while not on the job) may be optional. Contact your state’s WC board (listed in the phone book) to learn of your rights and obligations.

## BUSINESS INSURANCE

General liability (third-party) insurance covers you should your business cause damage or injury to your client or a third party. An example would be if you happened to knock over your client’s neighbor’s fence when maneuvering the mill, or if sawdust got in an onlooker’s eye, resulting in a trip to the

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emergency room. A circumstance that is especially relevant to sawmill operators is that of having clients or their representatives assist with the work. If they become injured, then they (or their family) quite likely will seek compensation from either your general liability or WC insurance. If the injured person was essentially working for you as your employee, you may be responsible for such benefits. Either way, their help may not be worth the risk.

It may be wise to also get an “equipment floater” or “inland marine” rider to cover your mill as a piece of mobile equipment. That will cover damage to it whether on the road, at your home, or at a job site. Your regular automobile insurance may cover damage you cause to other vehicles while on the road. It would be wise to inform your automobile insurance agent of your new business to be sure you are covered under various scenarios.

Without question, the “best insurance policy” is

not to need one in the first place. Use common sense and follow safe work and business practices. Consult with your insurance agent and a safety expert, and acquire required and adequate coverage. Don’t leave the fate of your business (indeed, your personal financial future) to chance.

## **STATE UNEMPLOYMENT INSURANCE COSTS**

If you are an employer, you are responsible for contributions to the state unemployment insurance fund. This is a percentage of gross annual employee wages. It varies by business and employer, but for seasonal and temporary employment situations, such as sawmilling, the rate is often relatively high. The current highest rate in the state of New York is 8.7% of the first \$8,500 (or any part thereof) of wages. You will need to check with your state to determine the rate for your situation.

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# Financial Analysis

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This analysis is based on the use of a spreadsheet (using Microsoft Excel software) that estimates the annual profits of owning and operating a portable sawmill. A free copy of the spreadsheet can be downloaded from: [WWW.NATURALRESOURCES.UMD.EDU/PUBLICATIONS.CFM#RURALENTERPRISESERIES](http://WWW.NATURALRESOURCES.UMD.EDU/PUBLICATIONS.CFM#RURALENTERPRISESERIES).

The information provided in the spreadsheet and the following profit scenarios (see Table 1 on page 25) are only examples. Your unique circumstances must be accurately analyzed before you can make wise financial decisions. The spreadsheet and profit scenarios should give you an idea of the variables, process, and calculations necessary to conduct your economic analysis. The true power of a computer spreadsheet analysis is the ease and speed by which the user can assess the results of adjusting various individual or combinations of variables. For example, what will be the impact to the bottom line (profit) if you can increase the downpayment by \$1,000? Or what if you instead use the \$1,000 to buy a different mill, one that can produce an additional hundred board feet per day? Such “what if?” scenarios can be analyzed quickly and accurately.

We suggest that you work through the given examples even if you don’t intend to use the spreadsheet via a computer analysis. The process and most of the categories are straightforward, applicable, and useful even just with the use of a handheld calculator.

The spreadsheet and scenarios are set up primarily to examine custom sawing for a fee based on production. Production rate, and therefore your earnings, will vary depending on the size and quality of the logs and the dimensions of the sawn lumber. An

alternative is to charge by the hour (\$35 per hour is a common rate). Charging by the hour helps to stabilize owner-operator income, but customers may prefer to pay on the basis of production.

## THE SPREADSHEET

The spreadsheet on the following page is provided to help entrepreneurs calculate annual profitability. The numbers provided illustrate a realistic example, based on the owner-operator working an eight-hour day. The spreadsheet is broken down into three sections: 1) Annual Income, 2) Annual Expenses, and 3) Net Annual Cash Flow. You can use the form to estimate your income and expenses whether you plan to charge for your services on an hourly basis or on a board-foot basis. This analysis is for a one-year period during which you own and operate the sawmill as a business. It cannot be used for analyzing individual jobs.

The following instructions contain titles, each identified by a capital letter or letter combination, that correspond with those in the spreadsheet. Most of the lines on the form are self-explanatory, but you may want to refer to the instructions if you need help with any line. Formulas are included on those lines that need to be calculated. If you are using the electronic version of the form, found at [WWW.NATURALRESOURCES.UMD.EDU](http://WWW.NATURALRESOURCES.UMD.EDU), these lines will be calculated for you. However, if you are using the paper version, a handheld calculator will be useful in completing these lines. Sample numbers are given, but these are for illustration purposes only. You should estimate your profit and cash flow using your own numbers.

## Portable Sawmill Profitability Spreadsheet—Annual Profit Report

The shaded boxes in the “Values You Input” column are the only ones that will take entries in the electronic format. The other values are calculated automatically in a spreadsheet program, or can be done manually using the formulas provided.

	SAMPLE ENTERPRISE	CALCULATED VALUES	VALUES YOU INPUT
<b>Annual Income</b>			
<b>Billable Hours</b>			
A. Days you will cut per month (based on an 8-hour day)	10		
B. Months you will cut per year	6		
C. Days you will cut per year [A*B]		60	
D. Hours you will cut per year [C*8]		480	
<b>Hourly Rate</b> — If you charge on an hourly basis, proceed to line H (skip lines E, F, and G)			
E. Estimated output per day (in board feet, based on an 8-hour day)	1,000		
F. Your sawing rate (dollars per board foot)	\$0.25		
G. Your effective hourly rate (enter this into line H, below) [(E*F)/8]		\$31.25	
H. Your hourly rate (dollars per hour)	\$31.25		
I. TOTAL Annual Income [D*H]		\$15,000.00	
<b>Annual Expenses</b>			
<b>Variable Expenses</b>			
J. Daily operating expenses (e.g., fuel, repairs, and blades)	\$37.00		
K. Annual operating expenses [C*J]		\$2,220.00	
<b>Employee Expenses</b>			
L. Employees hired	0		
M. Hourly wage rate	\$10.00		
N. Hours worked per day	8.00		
O. Days hired per year	30		
P. Employee wage total [L*M*N*O]		\$0.00	
<b>Additional Employee Expenses</b>			
Q. Worker compensation rate (%)	55		
R. Worker compensation payment [P*(Q/100)]		\$0.00	
S. Unemployment insurance rate (%)	8.7		
T. Unemployment insurance payment [P*(S/100)]		\$0.00	
U. TOTAL Employee Expenses [P+R+T]		\$0.00	
V. TOTAL Variable Expenses [K+U]		\$2,220.00	
<b>Fixed Expenses</b>			
W. Insurance payment	\$1,200.00		
<b>Purchase with Loan</b>			
X. Sawmill purchase price	\$14,000.00		
Y. Down payment	\$2,800.00		
Z. Amount financed [X-Y]		\$11,200.00	
AA. Loan length (years)*	3		
BB. Interest rate on loan (%)	12		
CC. Monthly payment [(Z*(BB/1200))/(1-(1+(BB/1200)) <sup>-(AA*12))]</sup> **		\$372.00	
DD. Annual loan payments [CC*12] **		\$4,464.00	
EE. TOTAL Fixed Expenses [W+DD]		\$5,664.00	
FF. TOTAL Annual Expenses (Variable and Fixed) [V+EE]		\$7,884.00	
<b>Annual Cash Flow</b>			
GG. Net Annual Cash Flow [I-FF]		\$7,116.00	
HH. Average monthly cash flow [GG/12]		\$593.00	
II. Owner's portion per billable hour [GG/D]		\$14.82	
What does the <i>owner's portion per billable hour</i> mean?			
This is the fruit of your labors and must cover your own labor; your time for setup, transport to and from sites, and providing bids; and the 15.3% social security an owner-operator must pay on income when self-employed			

\* This cell must contain a number other than 0, whether a loan is in effect or not.

\*\* The calculation for this cell is complicated. If you are working it out on paper rather than with a computer, you will need a calculator that can do exponentiation (raising to a power of).

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## Annual Income

- A. DAYS YOU WILL CUT PER MONTH—When you make this estimate, allow for any downtime. This assumes an eight-hour day.
- B. MONTHS YOU WILL CUT PER YEAR—You will probably not cut every month of the year. For instance, there may be times when it is too wet to get into the woods.
- C. DAYS YOU WILL CUT PER YEAR—This is calculated (in the computer spreadsheet, this is done automatically) by multiplying the DAYS YOU WILL CUT PER MONTH times the MONTHS YOU WILL CUT PER YEAR.  $[A \times B]$
- D. HOURS YOU WILL CUT PER YEAR—This is calculated by multiplying the DAYS YOU WILL CUT PER YEAR times eight hours.  $[C \times 8]$
- E-G. If you charge on an hourly basis, skip to H. Otherwise, see the sidebar on this page.
- H. YOUR HOURLY RATE—Enter your hourly rate, or if you charge on a board-foot basis, enter the amount from line G (see sidebar).
- I. TOTAL ANNUAL INCOME—This is the HOURS YOU WILL CUT PER YEAR multiplied by YOUR HOURLY RATE.  $(D \times H)$

## Annual Expenses

### VARIABLE EXPENSES

This set of expenses will vary depending on the amount of lumber sawn, number of days worked, number of times the mill is moved, amount of employee expenses, etc. For example, it may take 50% more gas to cut 1,500 board feet than to cut 1,000 board feet of the same type of material.

- J. DAILY OPERATING EXPENSES (e.g., fuel, repairs, and blades)—An estimate of this information may be obtained from the portable sawmill's manufacturer or your own experience.

- K. ANNUAL OPERATING EXPENSES  $(C \times J)$

### Employee Expenses

- L. EMPLOYEES HIRED

- M. HOURLY WAGE RATE—For example, \$10 per hour

- N. HOURS WORKED PER DAY—If an employee works from 8:00 a.m. to 5:00 p.m. with an hour for lunch, the employee works an eight-hour day.

- O. DAYS HIRED PER YEAR

### Determining your effective hourly rate, if you charge on a board-foot basis

Lines E, F, and G will help you convert a rate based on board feet produced to an effective hourly rate. If you charge on an hourly basis, you can proceed to line H (skip over lines E, F, and G). If you haven't yet decided how to charge, this section can help you see the relationship between production-based and time-based rates.

- E. ESTIMATED OUTPUT PER DAY (based on an eight-hour day)—The amount cut per day is dictated by the type of machine that you buy, as well as other factors. Enter a realistic average based on days with and without help, good and bad days, and days with and without breakdowns. Equipment manufacturers provide guidelines but these may be overly optimistic.
- F. YOUR SAWING RATE (dollars per board foot)—In the Northeast, cutting charges range from twenty to thirty-five cents per board foot.
- G. YOUR EFFECTIVE HOURLY RATE—This is determined by multiplying your ESTIMATED OUTPUT PER DAY times YOUR SAWING RATE and then dividing by eight hours.  $[(E \times F) / 8]$  You can now enter this amount into line H.



- 
- P. EMPLOYEE WAGE TOTAL—Calculated by multiplying the EMPLOYEES HIRED times the HOURLY WAGE RATE times the HOURS WORKED PER DAY times the DAYS HIRED PER YEAR.  $(L \times M \times N \times O)$

### *Additional Employee Expenses*

- Q. WORKER COMPENSATION RATE (%)—Enter your state worker compensation rate percentage.
- R. WORKER COMPENSATION PAYMENT—Multiply the EMPLOYEE WAGE TOTAL by the total of the WORKER COMPENSATION RATE divided by 100.  $[P \times (Q/100)]$
- S. UNEMPLOYMENT INSURANCE RATE (%)—Enter your state unemployment rate percentage.
- T. UNEMPLOYMENT INSURANCE PAYMENT—Multiply the EMPLOYEE WAGE TOTAL times the total of the UNEMPLOYMENT INSURANCE RATE divided by 100.  $[P \times (S/100)]$
- U. TOTAL EMPLOYEE EXPENSES—The sum of EMPLOYEE WAGE TOTAL, WORKER COMPENSATION PAYMENT, and UNEMPLOYMENT INSURANCE PAYMENT.  $[P + R + T]$
- V. TOTAL VARIABLE EXPENSES  $[K + U]$

### **FIXED EXPENSES**

- W. INSURANCE PAYMENT—Insurance coverage should include at least liability, comprehensive, theft, and transportation. This type of coverage will typically range from \$900 to \$1400 annually. This information may be obtained from an insurance agent.

### *Purchase with Loan*

Mills are often purchased with a loan.

- X. SAWMILL PURCHASE PRICE—This is the total purchase price of your portable sawmill (this should include any state sales taxes, extra equipment bought with the mill, etc.).
- Y. DOWN PAYMENT—Typically twenty percent of the SAWMILL PURCHASE PRICE.

- Z. AMOUNT FINANCED—SAWMILL PURCHASE PRICE minus DOWN PAYMENT.  $[X - Y]$

- AA. LOAN LENGTH (years)—This is the length of time it will take to pay off the loan. Typically, a three- to four-year loan is appropriate for this type of purchase.

- BB. INTEREST RATE ON LOAN (%)—This is the annual interest rate charged by the bank on your loan. A conservative estimate is twelve percent.

- CC. MONTHLY LOAN PAYMENT—A standard financial formula is used to calculate a monthly loan payment based on the AMOUNT FINANCED, the LOAN LENGTH, and the INTEREST RATE ON LOAN. The amount is calculated automatically on the spreadsheet you can download. However the actual formula is  $(Z * (BB/100/12)) / (1 - (1 + (BB/100/12))^{-AA * 12})$ . To calculate the loan payment requires a calculator that can handle exponents (raising one number to a power of another). This information can be found at numerous Web sites or from most banks. Search for “financial calculators.”

- DD. ANNUAL LOAN PAYMENT—The MONTHLY LOAN PAYMENT multiplied by twelve.

- EE. TOTAL FIXED EXPENSES—The sum of INSURANCE PAYMENT and ANNUAL LOAN PAYMENT.  $(W + DD)$

- FF. TOTAL ANNUAL EXPENSES—The sum of TOTAL VARIABLE EXPENSES plus TOTAL FIXED EXPENSES.  $[V + EE]$

### *Net Annual Cash Flow*

- GG. NET ANNUAL CASH FLOW—The TOTAL ANNUAL INCOME minus the TOTAL ANNUAL EXPENSES.  $[I - FF]$

- HH. AVERAGE MONTHLY CASH FLOW—The NET ANNUAL CASH FLOW divided by twelve.  $[GG/12]$

- II. OWNER'S PORTION PER BILLABLE HOUR—The NET ANNUAL CASH FLOW divided by the HOURS YOU WILL CUT PER YEAR.  $[GG/D]$

A note on the spreadsheet points out that the OWNER'S PORTION PER BILLABLE HOUR does not translate to an hourly pay rate. It is not only recompense for the owner's labor during billable hours, but also must cover the time and effort involved in transport and set-up of the mill, providing bids, bookkeeping and other forms of paperwork, and of course, the 15.3% social security taxes due on income from self-employment. It is in your best interest to learn to do those non-billable chores as efficiently as possible.

Other ways of perhaps increasing the profit margin include: raising your fee, increasing daily production, working more days, reducing expenses, etc. Those kinds of decisions are what running a business is all about! Ideally, this spreadsheet will allow you to assess the results of those decisions quickly and accurately.

### THREE SCENARIOS

To illustrate potential profits, three scenarios have been depicted with various associated factors (refer to TABLE 1). Scenario 1 is a small, manual, portable sawmill that costs approximately \$6,000, saws 500 to 800 board feet per day, and is run by the owner-operator. Scenario 2 is a medium-size, partially automated, portable sawmill that costs approximately \$16,000, saws about 1,000 to 1,500 board feet per day, and is run by the owner-operator plus one employee. Scenario 3 is a large, automated, portable sawmill that costs approximately \$24,000, saws about 2,000 to 3,000 board feet per day, and is run by the owner-operator plus one employee. These prices reflect the mid-range for new mills in those categories. Good, used mills are available at substantial

purchase price savings. Production rates and repair costs should be adjusted accordingly if the spreadsheet is used to analyze used mills.

The three scenarios are analyzed to give typical returns under various operating situations. For each scenario the assumed costs and charges are shown in TABLE 1. Each scenario was run using a sawing charge of \$0.25 per board foot, which is a current competitive fee. This is the amount the owner would charge a client to custom produce lumber from logs provided by the client. The logs would be located on a level area immediately adjacent to the site where the mill would be placed and operated. The sawing charge may have to be adjusted to account for other log location considerations. Two levels of daily production are assumed for each unit size, as shown in TABLE 1.

Each scenario and production rate is run for a set of assumed sawing days per year (from 16 to 104) as depicted in FIGURE 1. The break-even point is where the particular bar crosses the zero line. This would be the minimum number of days necessary to operate to cover fixed costs for that year; the point where the business generates a profit. The figure is provided solely to enable the reader to visualize the relative

**Table 1. Portable sawmill scenarios**

UNIT SIZE	SMALL	MEDIUM	LARGE
Daily Production (board feet)			
Low	500	1,000	2,000
High	800	1,500	3,000
Machine Cost	\$6,000	\$16,000	\$24,000
Daily Operating Cost	\$30	\$40	\$50
Number of Employees	0	1	1
Wage (\$/hour)	NA	\$10	\$10
Worker Comp. Rate	NA	55%	55%
Other Annual Costs	\$500	\$700	\$900
Annual Insurance Payments	\$560	\$1,120	\$1,680
Loan Length (years)	3	3	3
Finance Rate	10%	10%	10%

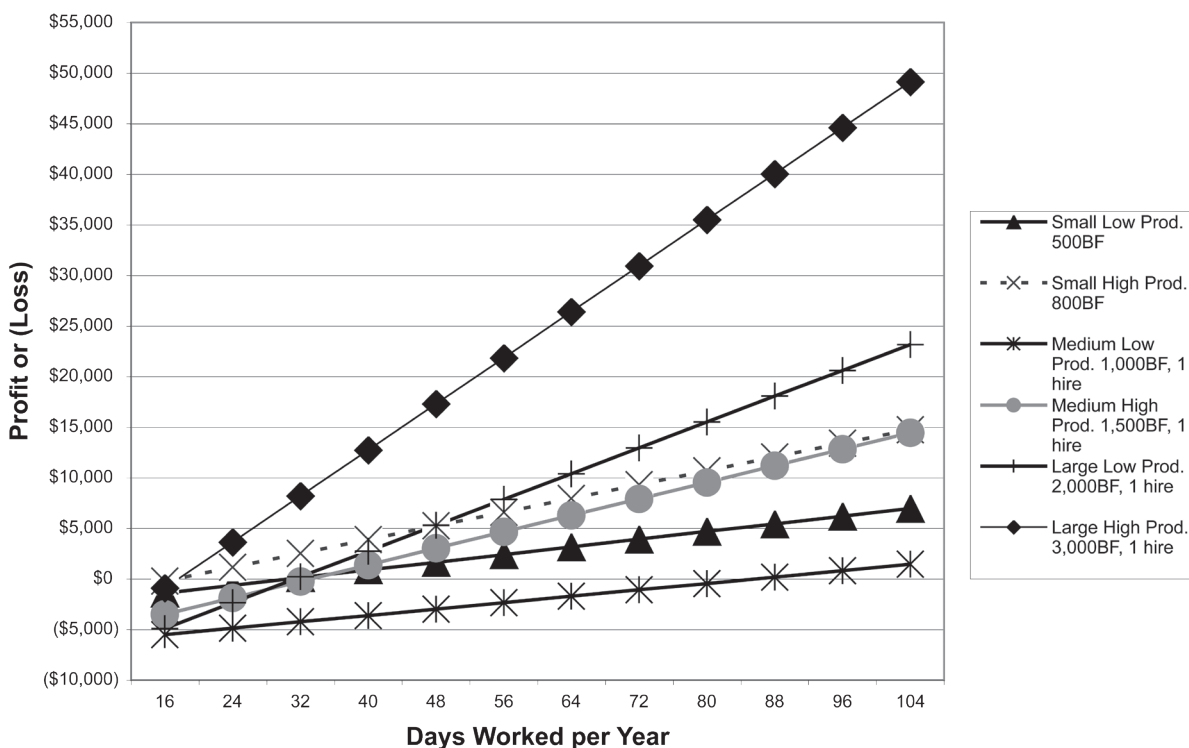
profit differences among the mills using the stated variables. Changes in the specific variables will shift either the starting point (ex. machine cost) or the slope of the line (ex. production rate) accordingly.

Using the \$0.25 per board foot charge, the break-even point for the Small Unit with “Low Production”, the Medium Unit with “High Production” and the Large Unit with “Low Production” are very similar; approximate 32 to 40 days per year. For the Large Unit with “High Production”, the break-even point is very low at approximately 20 days per year. This is due to its large output. Although the initial cost is much more, the larger daily production more than compensates for this.

The Medium Unit with “Low Production” requires the longest period at 88 days to reach the break-even point under the assumed conditions. This is due to employee wages and Worker Compensation fees coupled with the higher investment

cost, but only a slight increase in output over the Small Unit where there are no employee costs. These results should be interpreted with some caution. For example, achieving the high annual output for the Large Unit would require active salesmanship by the owner to find clients to keep the machine busy. In addition, markets for lumber may have to be located or perhaps clients may wish to sell the lumber. In addition, while the number of production days may seem quite modest, this may be high if one is doing this as a “second” occupation. An operator should be strong willed enough to charge more for difficult sites to compensate. Finally, the scenarios assume the following: all is working well; normal maintenance is being done; movements to each site are uncomplicated; the logs are clean and of average size and sawing difficulty; the operator and hired labor can work at a consistent rate for the 8-hour day without diminishing productivity.

**Figure 1. Annual profits for portable sawmills (\$0.25/BF charge)**



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Based on these results, it appears that a prospective owner-operator of a portable sawmill might well consider buying either a small unit with low daily output and a relatively low initial cost, or a fairly large unit that is more mechanized and can produce much more lumber than a small unit. But if the operator of the medium mill didn't hire an assistant the profit margin would improve substantially (even in consideration of reduced production rate). With the larger unit the operator would most likely require an additional person to help to optimize production rate, as used in these scenarios. In addition, the larger unit might require a larger, 4-wheel drive pickup to move it and possibly an ancillary tractor to move logs to the unit to keep production optimized all day.

Although mills can be profitable, to be realistic, there will be times when cash flow is poor due to

poor sales on lumber, slow payments, high log costs and/or inventory, high maintenance costs, quarterly tax payments, etc. There are some days where you will saw all day and not make any money or profit until the lumber is sold.

## CONCLUSIONS

The true value of the spreadsheet and profit scenarios is to demonstrate the importance of balancing expenses against production and being able to calculate a break-even point with which you are comfortable. These financial analysis tools should be able to help you make wise choices before making purchase commitments. Then, once the business is up and running, routinely reassess methods by which to enhance your efficiency and improve that all-important bottom line.

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## APPENDIX A

### Information References and Sources of Assistance

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#### Associations

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|---|--|
| American Forests<br>PO Box 2000, Washington, DC 20013<br><a href="http://WWW.AMERICANFORESTS.ORG">WWW.AMERICANFORESTS.ORG</a><br>(Publishes <i>American Forests Magazine</i> )  | National Hardwood Lumber Association<br>6830 Raleigh-LaGrange Rd., Memphis, TN 38184-0518<br>901-377-1818<br><a href="http://WWW.NATLHARDWOOD.ORG">WWW.NATLHARDWOOD.ORG</a>  |
| National Woodland Owners Association<br>374 Maple Ave. East, Suite 310, Vienna, VA 22180<br>1-800-476-8733<br><a href="http://WWW.WOODLANDOWNERS.ORG">WWW.WOODLANDOWNERS.ORG</a><br>(Publishes <i>National Woodlands Magazine</i> ) | Society of American Foresters<br>5400 Grosvenor Lane, Bethesda, MD 20814-2198<br>301-897-8720; tollfree: 1-866-897-8720<br><a href="http://WWW.SAFNET.ORG">WWW.SAFNET.ORG</a><br>(Publishes <i>Journal of Forestry</i> ) |
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#### Magazines

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| <i>American Lumber and Pallet</i><br>P.O. Box 1136,<br>Fayetteville, TN 37334<br>1-800-992-3432<br><a href="http://WWW.AMLUMBER.COM">WWW.AMLUMBER.COM</a>  | <i>Logging Management</i><br>203-2323 Boundary Rd.,<br>Vancouver, BC V5M 4V8<br>Canada<br>604-298-3005<br><a href="http://WWW.BAUMINTERNATIONAL.COM/PUBLICATIONS/LM/LOGMG_MAIN.HTM">WWW.BAUMINTERNATIONAL.COM/<br/>PUBLICATIONS/LM/LOGMG_MAIN.HTM</a> | <i>Southern Lumberman</i><br>Greysmith Publishing Inc.<br>P.O. Box 681629,<br>Franklin, TN 37068<br>615-791-1961   |
| <i>Forest Products Journal</i><br>2801 Marshall Court,<br>Madison, WI 53705-2295<br>608-231-1361<br><a href="http://WWW.FORESTPROD.ORG/FPJONLINE.HTML">WWW.FORESTPROD.ORG/<br/>FPJONLINE.HTML</a>        | <i>Northern Logger &amp;<br/>Timber Processor</i><br>The Northeastern Loggers'<br>Association<br>Box 69,<br>Old Forge, NY 13420<br>315-369-3078<br><a href="http://WWW.NORTHERNLOGGER.COM">WWW.NORTHERNLOGGER.COM</a>                                 | <i>Tree Farmer</i><br>1111 19th St. NW Suite 780,<br>Washington, DC 20036<br>202-463-2462<br><a href="http://WWW.TREEFARMSYSTEM.ORG">WWW.TREEFARMSYSTEM.ORG</a>                              |
| <i>Independent Sawmill &amp;<br/>Woodlot Management</i><br>Sawmill Publishing L.L.C.<br>P.O. Box 1149,<br>Bangor, ME 04402<br>207-945-9469<br><a href="http://WWW.SAWMILLMAG.COM">WWW.SAWMILLMAG.COM</a> | <i>Pallet Enterprise</i><br>Hatton-Brown Publishers<br>P.O. Box 2268,<br>Montgomery, AL 36102-2268<br>334-834-1170<br><a href="http://WWW.SOUTHERNLUMBERMAN.COM">WWW.SOUTHERNLUMBERMAN.COM</a>  | <i>Timber Processing</i><br>Hatton-Brown Publishers<br>P.O. Box 2268,<br>Montgomery, AL 36102-2268<br>334-834-1170<br><a href="http://WWW.TIMBERPROCESSING.COM">WWW.TIMBERPROCESSING.COM</a> |
| <i>Logging &amp; Sawmilling Journal</i><br>P.O. Box 86670,<br>North Vancouver, BC V7L 4L2<br>Canada<br><a href="http://WWW.FORESTNET.COM">WWW.FORESTNET.COM</a>  |   | <i>TimberLine</i><br>Industrial Reporting, Inc.<br>10244 Timber Ridge Rd.,<br>Ashland, VA 23005<br>804-550-0323<br><a href="http://WWW.TIMBERLINEMAG.COM">WWW.TIMBERLINEMAG.COM</a>          |

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## Sources of Assistance and Web Sites

### COOPERATIVE EXTENSION SERVICE—PERSONNEL IN FOREST MANAGEMENT AND WOOD PRODUCTS

Call your local Cooperative Extension office or your state extension forester for more information on publications and assistance. A list of state Extension contacts is available on the Internet at the Web site of the USDA Cooperative State, Research, Education, and Extension Service at [www.csrees.usda.gov/qlinks/partners/state\\_partners.html](http://www.csrees.usda.gov/qlinks/partners/state_partners.html). By clicking on your state you can access information on local extension contacts, publications, and other resources.

### STATE FORESTRY AGENCIES—WOOD UTILIZATION

Many states have wood utilization departments that can help you or put you in contact with others. Contact your state forester for assistance available in your state. A list of state forest agency contacts is available on the Internet at the Web site [www.stateforesters.org/sflist.html](http://www.stateforesters.org/sflist.html).

### SAWING AND RELATED PROCESSES, A LIST OF PUBLICATIONS, USDA, FOREST PRODUCTS LABORATORY

This list has many publications that are available in PDF format and have to with just about everything from logs to lumber to measurements. View the list at [www.fpl.fs.fed.us/document-lists/sawlist.html](http://www.fpl.fs.fed.us/document-lists/sawlist.html).

[HTTP://FORESTRY.ABOUT.COM/LIBRARY/WEEKLY/AA021499.HTM?TERMS=SAWMILLS](http://forestry.about.com/library/weekly/aa021499.htm?terms=sawmills)—This Web site has an excellent guide on the type of sawmill that is right for you.

[WWW.NATLHARDWOOD.ORG](http://www.natlhardwood.org)—National Hardwood Lumber Association (NHLA) is a trade association of companies and individuals that produce, sell, and use North American hardwood lumber, or provide equipment, supplies, or services. Founded in 1898 to establish a uniform system of grading rules.

[WWW.SAWMILLEXCHANGE.COM](http://www.sawmillexchange.com)—Helps people buy and sell used portable sawmills and related equipment. Includes a page containing a list of tips and advice on buying a mill from current owners of portable sawmills.

[WWW.WOODWEB.COM](http://www.woodweb.com)—Log on here for woodworking information, including resources, forums, and discussion boards.

[WWW.WOODPLANET.COM](http://www.woodplanet.com)—An online database of sawmills, reman operations, other primary and secondary manufacturers, wholesalers, and brokers. This database includes information for over 30,000 wood products suppliers.

### BUSINESS AND TAXES

[WWW.SBAONLINE.SBA.GOV](http://www.sbaonline.sba.gov)—The United States Small Business Administration is a great source of information and technical assistance.

[WWW.IRS.GOV](http://www.irs.gov)—The I.R.S. Web site is an indispensable source of information, forms, and publications for any small business.

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## APPENDIX B

### Portable Sawmill Manufacturers

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Bailey's Inc.  
P.O. Box 550, 44650 Hwy. 101,  
Laytonville, CA 95454  
Phone: 800-322-4539 or 707-984-6133  
Fax: 707-984-8115  
Email: BAILEYS@BAILEYS-ONLINE.COM  
Web site: WWW.BAILEYS-ONLINE.COM

Baker Products  
P.O. Box 128, Ellington, MO 63638  
Phone: 573-663-7711 Fax: 573-663-2787  
Email: INFO@BAKER-ONLINE.COM  
Web site: WWW.BAKER-ONLINE.COM

Frickco Inc.  
54660 Pretty Run Rd.,  
South Bloomingville, OH 43152  
Phone: 740-887-3799 Fax: 740-887-2017  
Email: ALBRIGHT@BRIGHT.NET  
Web site: WWW.BRIGHT.NET/~ALBRIGHT

Heartwood Saw  
#525 Bellevue Drive, R.R. #5, Belleville  
Ontario, Canada, K8N 4Z5  
Phone: 888-497-2926 or 613-969-8495  
Fax: 613-969-0143  
Email: INFO@HEARTWOODSAW.COM  
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Barneveld, NY 13304  
Phone: 800-765-7297 Fax: 315-896-2627  
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*Inclusion in this list does not constitute an endorsement  
of the company or nor is exclusion intended to reflect  
adversely upon the reputation of the company.*

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## APPENDIX C

### Sample Contract

A contract is the best way to ensure that the specifics of the job are clear to both parties and legally documented. A good contract protects the interests of both the sawyer and the customer. No surprises means no disagreements! The sample contract below is meant only as a guide. Modify it to suit your general or specific needs. (Adapted from *“Wood-Mizer & You: A Profitable Combination”* and *“How to Set Up and Run a Profitable Custom Sawing Business.”* Used with permission from Wood-Mizer Products, Inc., Indianapolis, IN, and TimberKing, Inc., Kansas City, MO)

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This agreement between (**Sawyer**) \_\_\_\_\_, (address) \_\_\_\_\_,  
and (**Customer**) \_\_\_\_\_, (address) \_\_\_\_\_, is as follows:

1. **Sawyer** agrees to saw customer's logs at site (address) \_\_\_\_\_.
2. **Sawyer** agrees to saw customer's logs at the rate of \$ \_\_\_\_\_ per board foot. Charges are based on actual lumber cut rather than scaled volume. A board foot is defined as a unit measuring 12" x 12" x 1".  
Specialty or custom work will be done at a rate of \$ \_\_\_\_\_ per hour. This work will include: (specify) \_\_\_\_\_.
3. **Customer** will pay **Sawyer** \$ \_\_\_\_\_ for initial set-up of sawmill and an additional set-up fee of \$ \_\_\_\_\_ each time **Sawyer** relocates sawmill on site.
4. **Customer** agrees to have sawing site prepared with logs cleaned and stacked for continuous loading up ramp onto mill, without moving the sawmill or further work on logs. **Customer** agrees to pay labor rate of \$ \_\_\_\_\_ per hour for work done by **Sawyer** (not sawing) cleaning logs, limbing/bucking logs, stacking lumber, repairing equipment damaged by dirty logs, prepping work site, etc. Other charges: \_\_\_\_\_.
5. **Customer** agrees to pay \$ \_\_\_\_\_ for each damaged blade and \$ \_\_\_\_\_ for each broken blade due to dirty logs or foreign material (rocks, metal, etc.) in logs.
6. **Sawyer** agrees to arrive on work site at \_\_\_\_\_ p.m/a.m. on \_\_\_\_\_, 20\_\_\_\_\_.  
**Sawyer** agrees to reduce final bill by \$ \_\_\_\_\_ per hour (and any portion thereof) of tardiness.
7. Payment shall be made on the following terms: Deposit: \$ \_\_\_\_\_.  
Balance: \$ \_\_\_\_\_ payable: \_\_\_\_\_.
8. **Customer** will provide labor for loading logs, unloading lumber, and stacking lumber. **Customer** understands that log handling and sawing can be dangerous and will (or helper) wear head, ear, and eye protection provided by **Sawyer**. **Customer** will also be responsible for conduct of helpers and observers and agrees to hold **Sawyer** harmless for any injury or damage whatsoever to helpers or observers out of operation of the mill and the handling of logs/lumber. It shall be the **Customer's** duty to keep children, pets, and unauthorized people out of the work area.
9. **Customer** represents that he/she is the owner of the logs and/or has authority to enter into this Agreement on behalf of all interested parties.

Dated and effective: (month) \_\_\_\_\_, (day) \_\_\_\_\_, (year) \_\_\_\_\_.

**Sawyer:** X \_\_\_\_\_ **Customer:** X \_\_\_\_\_

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## APPENDIX D

### Glossary

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**BOARD FOOT:** A piece of lumber one inch thick that measures 12"×12".

**CANT:** The main portion of a log after being sawn on two sides; intended for further sawing or to be used as a building log.

**CHECK:** A lengthwise separation of the wood that usually extends across the rings of annual growth and parallel to the wood rays. Checks result from drying stresses.

**Surface:** A check starting on a wide-grain surface and extending into the interior of a board.

**End:** A check starting on an end-grain surface and extending along the length of a board.

**Internal:** Checks originating in the interior of a piece of wood or extensions of surface and end checks.

**CULL:** A tree or log of merchantable size, but having no marketable value because of rot or other defects.

**CUP:** A distortion of a board in which there is deviation from flatness across the width of the board.

**DECAY:** The decomposition of wood substance by fungi.

**Advanced:** The older stage of decay in which the destruction is readily recognized because the wood has become punky and soft.

**Incipient:** The early stage of decay that has not proceeded far enough to soften or otherwise perceptibly impair the hardness of the wood. It is usually accompanied by a slight discoloration or bleaching of the wood.

**DEGRADE, KILN:** A drop in lumber grade that results from kiln drying.

**DIMENSION LUMBER:** Hardwood dimension lumber is processed to be used whole in the manufacture of furniture or other products. Softwood dimension lumber consists of boards more than two inches thick but less than five inches thick. This wood is used in construction and is sold as two-by-fours, four-by-eights, or two-by-tens.

**EDGING:** A piece of lumber that has to be trimmed to width, thereby removing the bark. Usually the bark is on both edges of the board.

**END COATING:** A coating of moisture-resistant material applied to the end-grain surface to retard end drying of green wood or to minimize moisture changes in dried wood.

**EQUILIBRIUM MOISTURE CONTENT:** The moisture content at which wood neither gains nor loses moisture when surrounded by air at a given relative humidity and temperature.

**FIBER SATURATION POINT:** The stage in the drying or wetting of wood at which the cell walls are saturated with water and the cell cavities are free from water. It is usually taken as approximately 30 percent moisture, based on the weight of oven-dried wood. Drying below the fiber saturation point will result in wood shrinkage.

**FLAT-SAWN:** Lumber sawn in a plane approximately perpendicular to a radius of the log.

**FLITCHES:** Lengthwise cuts of a tree trunk.

**GRADED LUMBER:** Dimension lumber that has been assessed at a sawmill based on the number, character, and location of features that may lower the strength, durability, or utility value of the lumber. Establishment of grading procedures is largely the responsibility of manufacturers' associations.

**GRAIN:** The general direction of the fibers in wood or lumber.

**HARDWOODS:** Woods produced by one of the botanical groups of trees that have broad leaves in contrast to the needles or scale-like leaves of the conifers or softwoods. The term has no reference to the actual hardness of the wood.

**HEARTWOOD:** The wood extending from the pith to the sapwood, the cells of which no longer participate in the life processes of the tree. Heartwood may be infiltrated with gums, resins, and other materials that usually make it darker and more decay resistant than sapwood.

**KILN:** A heated chamber for drying lumber, veneer, and other wood products, in which temperature and relative humidity are controlled.



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**KILN SAMPLE:** A section 30 cm or more in length cut from a sample board and placed in the kiln charge so that it can be removed for examination, weighing, and testing.

**LUMBER, SHIPPING-DRY:** Lumber and other wood products that have been air or kiln dried to a sufficiently low moisture content to prevent stain, mold, and decay in transit; generally taken to be 25 percent moisture content or less, based on the weight of oven dry wood.

**OFFBEARER:** Removes green veneer sheets or dimension lumber from conveyor in a sawmill and stacks them on designated carts.

**PULPWOOD:** Wood used to produce pulp used in the manufacture of paper products. Pulpwood is usually wood that is too small, of inferior quality, or the wrong species to be used in the manufacture of lumber or plywood.

**QUARTERSAWN:** Lumber sawn so the wide faces are approximately at right angles to the annual growth rings.

**RADIAL:** Coincident with or generally parallel to a radius of the tree from the pith to the bark. A radial section is a lengthwise section in a plane that passes through the pith.

**SOFTWOOD:** Wood produced by one of the botanical groups of trees, that, in most species, have needle or scale-like leaves.

**SPECIFIC GRAVITY:** The ratio of the oven dry weight of a piece of wood to the weight of an equal volume of water (at 4° C). In drying, specific gravity values are usually based on the volume of the green wood.

**STAIN:** A discoloration in wood that may be caused by microorganisms, metal, or chemicals. The term also applies to materials used to impart color to wood.

**Blue (Sapstain, Sapwoodstain):** A bluish or grayish discoloration of the sapwood caused by the growth of certain dark-colored fungi on the surface and in the interior of the wood, made possible by the same conditions that favor the growth of other fungi.

**Chemical:** A general term including all stains that are due to color changes of the chemicals normally present in the wood, such as pinking of hickory and browning of some softwoods, particularly the pines.

**Iron-Tannate:** A bluish-black surface stain on oak and other tannin-bearing woods following contact of the wet wood with iron, or with water in which iron is dissolved.

**Mineral:** An olive to greenish-black or brown discoloration in hardwoods, particularly maple, caused by bird peck or other injury and found either in mass discoloration or mineral streaks. The mineral associated with such streaks is frequently calcium oxalate, which has a tendency to dull machining knives.

**Sticker:** A gray to blue or brown chemical stain occurring on and beneath the surface of boards where they are in contact with stickers (also fungi sap stain when found only in the sticker area).

**Water:** A yellowish to blackish surface discoloration caused by water that dripped onto the wood during drying.

**Weather:** A very thin grayish-brown surface discoloration on lumber exposed for a long time to the weather.

**STICKER:** Strips of wood placed as spacers between tiers of lumber during drying so as to permit airflow through the pile.

**STRESS, DRYING:** An internal force, exerted by either of two adjacent parts of a piece of wood upon the other during drying, caused by uneven drying and shrinkage, and influenced by set.

**Tensile:** Stress in the outer layers of wood during the early stages of drying when the layers are trying to shrink but are regained by the still-wet interior region; also the stress in the interior layers later in drying as they try to shrink and are restrained by the set outer shell.

**Compressive:** Stress found in the interior region of wood during the early stages of drying, caused by the shrinking of the outer shell; also, stress in the outer layers in drying caused by the shrinking of the interior.

**TENSION WOOD:** A type of wood found in leaning trees of some hardwood species, characterized by the presence of fibers technically known as “gelatinous” and by excessive longitudinal shrinkage. Tension wood fibers tend to “pull out” on sawn and planed surfaces, giving so-called fuzzy grain. Tension wood causes crook and bow and may collapse. Because of slower than normal drying, tension wood zones may remain wet when the surrounding wood is dry.

**WANE:** Presence of bark or the lack of wood from any cause on the edge or corner of a piece.

**WARP:** Any variation from a true or plane surface. Warp includes cup, bow, crook, twist, and diamonding, or any combination thereof.

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