Is it Time to Revisit the Log-Sort Yard?

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Abstract

Log-sort yards provide better utilization and marketing with improved value recovery of currently available timber resources in North America. Log-sort yards provide many services in marketing wood and fiber by concentrating, merchandising, manufacturing, sorting, and adding value to logs. Such operations supply forest products firms with desired raw materials, which helps improve a company's bottomline by reducing the number of marginal logs processed. Successful log-sort yards are self-sufficient and have a good business plan, well-established markets, and a steady supply of wood. Concepts and analysis have broad application to effective marketing of a full range of multiple log products. The authors are preparing a guidebook for developing and operating successful log-sort yard operations.

Introduction

The forest products industry's interest in log-sort yards has increased over the last several years in response to timber supply issues. In addition, forest-dependent rural communities affected by changes in the timber supply are searching for ways to build diversified and sustainable local forest products businesses. Here also, a dependable supply of raw material is crucial.

Consequently, the authors are investigating potential opportunities for using log-sort yards to improve the timber supply for forest products businesses. In researching log-sort yards, the authors visited a number of operations in the United States and conducted an extensive literature search. One publication of particular interest is *A Handbook for Designing, Building, and Operating a Log Sort Yard* by Sinclair and Wellburn (1984). Basic concepts and the information from the log-sort yard visits and literature are applied toward improving log sorting and value recovery. This presentation outlines some main points about successful log-sort yard operations from preliminary findings.

Types of Log Yards

There are several different types of log yards serving any number of purposes. The traditional mill log yard provides receiving and log storage for feeding the mill. Concentration log yards provide a central point for accumulating logs for long-distance shipment to mill yards. Log reload yards provide transfer points between truck, rail, and barge transportation. A log-sort yard takes advantage of an integrated log market and serves several objectives by sorting logs for the best available market. The log-sort yard has its origin in water sorting yards where logs were sorted into rafts for shipment by water to the mill.

Log-Sort Yard Goals and Objectives

The goal of a log-sort yard is to improve the quality and productivity of log sorting, utilization, marketing, and distribution. This results in improved timber resource utilization and better bottomline business performance. Log-sort yards work to supply forest products industries with a log mix best suited to their operations. The objectives of a log-sort yard are to (1) concentrate logs for shipment; (2) improve log grading, scaling, and sorting; (3) improve merchandising; (4) add value to logs; (5) improve log marketing; and (6) reduce log flow bottlenecks from forest to mill.

Log-Sort Yard Functions

The basic functions shared by all log-sort yards are unloading/reloading, transport, grading, scaling, sorting, and log storage/inventory (Sinclair and Wellburn 1984).

Unloading/Reloading

Logs are usually transported to and from log-sort yards by log trucks, though sometimes they are transported by rail or barge. Loads vary in weight and, depending on the equipment used, may be unloaded in single or multiple passes. In small log-sort yards, front-end loaders are used for all functions; trucks are generally unloaded in multiple passes. In large log-sort yards, log stackers are often used for forwarding and unloading trucks in one pass, in which the entire load is lifted from the truck and transported to the sorting bays or storage deck. This process greatly reduces the truck waiting time involved in multiple-pass unloading. Other unloading methods include pushing and pulling the loads off the trucks. Logs are reloaded onto trucks or railcars for shipment to mills.

Transport

In every log-sort yard, logs are handled and transported (forwarded) from one function to another. In general, log flow through the yard is (1) unload, (2) grade, (3) scale, (4) sort, (5) store/inventory, and (6) reload. Depending on the size and capacity of the log-sort yard equipment, logs may be transported using the full capacity of forwarding machines or even as whole truckloads. Logs are sometimes transported a few at a time or individually (see Material Handling Concepts). The success of a log-sort yard often hinges on matching the forwarding equipment to the characteristics of the yard.

Grading

Grading or marking a log for a particular use and value is an essential process of any log-sort yard. For the grader to work efficiently, the logs are spread out so that all logs may be examined in the grading, scaling, and sorting bays. The sort is usually indicated on the log with spray paint. Other marking systems include color tags or crayon marks. Grading systems vary with the size of the log-sort yard. In some yards, the graders will indicate where a log should be bucked to upgrade it. Graders also assume quality control of the log-sort yard, watching for mismanufactured logs and excessive log damage.

Scaling

Common scaling methods are (1) weight scaling, where truckloads are weighed and the volume calculated by sample scaling a percentage of the total volume, and (2) stick scaling, where all logs are measured and recorded. Scaling by weight is preferred for material handling efficiency and productivity. Weight scaling reduces the time needed for scaling since only a percentage of the logs must be check-scaled to maintain the volume–weight ratios. Stick scaling determines the net volume after deductions for defects and grade of the log. The accuracy associated with stick scaling is important for high-value logs such as veneer peelers and high-quality sawlogs. Scalers normally scale logs after they are graded and bucked but before they are sorted. Several basic scaling accounting systems are in use.

Sorting

Log sorting, the primary function of the log-sort yard, can be performed with greatest accuracy if the logs are graded and marked beforehand. Sorting involves separating individually graded and scaled logs, and then grouping the logs. In general, logs are sorted by species and end use (e.g., pulpwood; small, medium, and large sawlogs; veneer peelers). Small log-sort yards make as few as 5 sorts and large yards, 20 or more sorts. The number of sorts, log size, and daily throughput influence the type and number of sorting machines required in the log-sort yard and affect log-sort yard productivity (see Log-Sort Yard Productivity).

Log Storage/Inventory

Although log inventory should be kept to a minimum, it may be necessary to temporarily store both sorted and unsorted logs. Sorted logs are not typically stored unless they must be accumulated for reload. Unsorted logs are stored to decouple production phases to improve operational flow. Decoupling through storage also improves safety by separating mobile equipment from graders, scalers, and other yard workers. Some yards store unsorted logs to balance daily and seasonal surges in log production. Some log storage is unavoidable, but the inventory should be controlled. Large log inventories in log-sort yards are a concern and every effort should be made to reduce the inventory.

Log-Sort Yard Equipment and Systems

Material-handling equipment can be divided into transport and sorting functions (Sinclair and Wellburn 1984). In large log-sort yards, log loaders are used primarily for sorting; log stackers and large front-end loaders are used for transporting. In small log-sort yards, lower capacity front-end loaders are used for both sorting and transporting logs. Sorting equipment can be used to sort logs and also bunch sorted logs for transport equipment. Similarly, lower capacity transport machines are used to accumulate logs in bunks for transport by higher capacity machines. Wherever possible, logs should be bunched before they are moved to use the full capacity of the transport machines. It is inefficient to use a front-end loader or log stacker to transport just a few logs across the log-sort yard (see Material Handling Concepts).

Front-End Loaders

Front-end loaders are general-purpose machines that can be used for unloading, transporting, and sorting, but they are not as efficient as specialized log-handling equipment (e.g., log stackers, log loaders, sorting tables, merchandising systems) in performing any of these functions. The front-end loader is best used for unloading a limited number of trucks, sorting large logs, and transporting logs for short distances. Because the front-end loader can do several functions, it is a good backup machine. Small front-end loaders are good for sorting because of their size and speed, but forwarding is limited by load capacity. Large loaders are best for forwarding bunches of logs, truck unloading, and reloading. Medium-sized loaders are good multipurpose machines for sorting, forwarding, loading, and unloading.

Log Stackers

Log stackers are used in medium to large log-sort yards and mill log storage yards where large loads need to be unloaded or transported for medium to long distances. These machines are capable of unloading a log truck or railroad log flatcar in a single pass. They efficiently spread logs in preparation for scaling and grading and are able to pile and retrieve logs from large storage decks.

Hydraulic Log Loaders

Log loaders are used primarily for sorting logs but may also be used to unload trucks, build log storage decks, and reload trucks. Loaders range from crawler-mounted and rubber-tired machines to log-truck-mounted machines. Stationary loaders may also be used to sort logs fed by a stacker or front-end loader into bunks. Logs are then transported by the stacker or front-end loader. In an alternative system, the log loader is mobile and works its way along the deck of spread logs (crawler-mounted units), bunching logs of the same sort. For stationary log sorting, unsorted logs are spread in front of the loader and then sorted into six to nine bunks located around the loader. In a variation of the stationary log loader system, the loader is located next to a mechanically operated sorting table (i.e., deck) or log merchandiser.

Log-Sorting Systems

Log-sorting tables, linear systems, and log merchandising systems were pioneered in Scandinavia for sorting logs into diameter classes at small log sawmills. These systems have gained in popularity in North

America. For system efficiency and high production rates, logs must be relatively small and uniform with little sweep. The greater volume of small-diameter material compared to available large logs makes these sorting systems attractive. Under the right conditions, the introduction of log merchandising systems improves productivity and value recovery in large log-sort yards.

Sorting Bunks

Sorting bunks are used to accumulate sorted logs. The designs and materials used for bunks depend on the volume of logs processed through the yard. Bunks are generally made of I-beams, steel plate, pipe, reinforced concrete, or wood piling.

Selection of Log-Sort Yard Equipment

The log-sorting system influences the type and size of machines needed. Log-sort yard size (physical size and number of pieces/day processed) also has a significant influence on the type of equipment used. Each sorting system and layout requires certain machine performance for various log-sort yard functions. One way to determine whether a machine will satisfy the demands is to visit existing log-sort yard operations. Log-handling equipment manufacturers also supply information on machine specifications and performance. Equipment for small, medium, and large log-sort yards by function are summarized in Table 1.

Table 1—Equipment for various yard sizes by log-sort yard function[a]

Function	Yard size[b]	Front-end loader	Log stacker	Log loader	sorting table[c]
Load & unload	Large	*	P	*	*
	Medium	S	S	*	*
	Small	P	*	*	*
Transport	Large	S	P	*	*
	Medium	S	S	*	*
	Small	P	*	*	*
sort	Large	*	*	P	P
	Medium	*	*	P	P
	Small	P	*	S[d]	*

Source: Sinclair and Wellburn 1984.

[a]S = suitable equipment, P = preferred, * = unsuitable or not applicable.

[b]Small< 40 million board feet (MMBF)/year, medium = 40–100MMBF/year, large = 100–300 MMBF/year.

[c]Includes linear systems and log merchandisers; generally for small-diameter, uniformly sized logs only.

[d]Note: In the Eastern United States, rubber-tire-mounted log loaders are preferred sorting machines.

Basic Log-Sorting Systems

Front-end loaders and both mobile and stationary log loaders are the primary machines used for sorting (Sinclair and Wellburn 1984). Sorting tables, linear log-sorting systems, and log merchandisers are also used to a lesser extent but gaining in popularity (see Log-Sort Yard Equipment and Systems). Small yards use front-end loaders to perform all machine functions. Sorting systems with front-end loaders have more flexibility than other sorting systems because front-end loaders can perform many log-sort yard functions (e.g., unloading, spreading, reclaiming, sorting, transporting). Large log-sort yards use stackers, front-end loaders, and log loaders in various combinations; specific job functions are often assigned to each machine. Log loaders can sort small pieces and build a better bundle of logs than can front-end loaders. Stationary log loaders achieve high sorting production rates, but more time is needed for handling (transporting) material compared to that required by mobile log loaders.

Front-End Loaders

Two systems are used when sorting logs with front-end loaders. In one system, a front-end loader works from the end of the grading and scaling bay and sorts the logs into piles. In the other system, the front-end loader moves along the side of the deck and pulls out the logs, generally pulling the large-volume sorts first. Sorted logs are bunched and forwarded to sorting bunks or storage bays.

Log Loaders

The mobile log loader typically sorts and bunches all logs in the deck area and behind itself in the travel corridor. After the deck has been sorted, the front-end loader pushes the remaining logs to the sorting bunks or sorted log storage, or reloads the logs directly onto trucks. The system used depends on the log size, number of sorts, and time available for forwarding. On the West Coast, high-capacity mobile crawler-mounted log loaders sort logs in the yard. Less expensive rubber-tired-mounted or log-truck-mounted loaders are used in the Eastern United States for sorting.

Stationary log loaders come in the same types and sizes as mobile loaders. Most stationary log loaders are

crawler mounted. Unsorted logs are spread in front of the loader and then sorted into bunks located around the loader. This system works best where the average log is relatively large and there are few sorts. Stationary log loaders are also used in conjunction with mechanical log-sorting tables and log merchandisers.

Material-Handling Concepts

Material handling in a log-sort yard involves inspection, operation, and inventory functions. All material handling involves a "pick" (i.e., pick up, transport, set down). Two prime rules govern material handling: (1) the shorter the distance traveled the cheaper the cost, and (2) the greater the weight per move the cheaper the cost per unit. The following principles of material handling apply to log-sort yards (Sinclair and Wellburn 1984):

- Reduce or eliminate unnecessary movements and combine movements
- Increase the size and weight of quantity of material moved wherever possible
- Standardize types and sizes of equipment
- Use equipment that can perform multiple tasks unless specialized equipment is needed
- Select equipment to match all aspects of material and flow in the system
- Minimize the ratio of dead weight to total weight for all moves
- Maximize the load and minimize the distance on high-intensity moves
- Make low-intensity moves if long distances must be covered
- Pick up and set down whole loads

A heavy load transported a short distance is the least expensive move. The most expensive is a light load transported a long distance. Log-sort yard layout should focus on maximizing loads transported within the yard and moving them short distances. Light loads should be combined if possible. The frequency of forwarding light loads for long distances should be minimized.

Log Storage/Inventory

Log storage serves to decouple log-sort yard operations. Storage is also used to improve log flow through the yard, smoothing out surges in production. Large log inventories in sort yards are a concern and every effort should be made to reduce the use of log inventory. Inventories perform four functions to improve the efficiency of log-sort yards (Sinclair and Wellburn 1984):

1. level or buffer surges in production,
2. decouple production phases,
3. smooth out fluctuations in log flow through the yard, and
4. accumulate loads.

Log-sort yards do not typically store sorted logs unless logs must be accumulated for reload. Some sort yards store unsorted logs to balance daily and seasonal surges in log production. Some log storage is unavoidable, but the inventory should be controlled.

Log-Sort Yard Layout

The best log-sort yard design depends on the volume of logs to be processed, site restrictions, and capital available for material-handling systems. An example of a basic log-sort yard layout is shown in Figure 1. The design of large log-sort yards is flexible. Three grading, scaling, and sorting bays can usually provide the needed surge area. A large log-sort yard can cover 10+ acres (4+ hectares). In medium log-sort yards, the sorting area is typically 5 acres (2 hectares), and in some small yards, the sorting area may be only 0.5 acre (0.2 hectares). High construction costs and low log volume dictate that small log-sort yards be as simple as possible. Log storage is limited to accumulating enough logs for reloads.

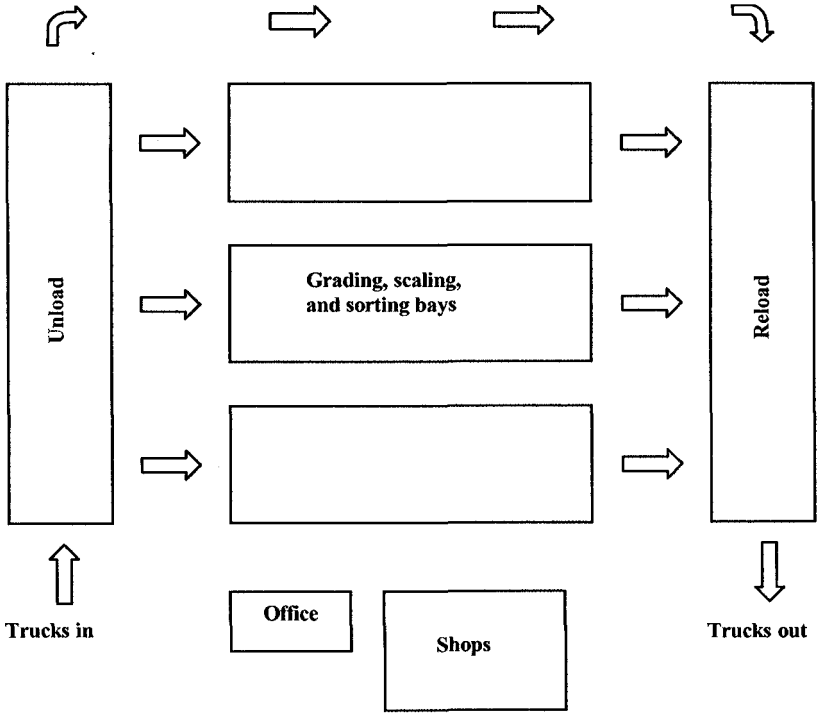

Figure 1—Example of basic log-sort yard layout

Log-Sort Yard Productivity

Pieces vs. Volume

The numbers of logs/machine hour and logs/employee day are the best measures of log-sort yard productivity. Volume/day is not a good measure of productivity because the time needed for grading, scaling, and sorting is about the same for small and large logs. Machinery requirements and number of employees are determined by the number of logs to be processed. A log-sort yard that processes short small-diameter logs will be less productive than a yard that processes longer large-diameter logs.

Cost vs. Value of Product

Effort expended in sorting should be in proportion to the value of the product. Scaling and sorting low-value logs should be done quickly and efficiently. Weight scaling also helps reduce cost to improve productivity and efficiency. Tracking measurement costs and productivity by piece (i.e., log) rather than by volume (i.e., MBF or cubic meter) helps identify the marginal log, which indicates minimal expense and effort. Presorting low-value logs before they reach the log-sort yard also helps improve yard productivity and efficiency.

Weight Scaling vs. Stick Scaling

Replacing stick scaling with weight scaling increases productivity and reduces costs of a log-sort yard. Yards that use weight scaling have higher employee day productivity than those that use stick scaling. Stick scaling should be reserved for high-value logs such as veneer peelers and high-quality sawlogs.

Number of Log Sorts

The fewer the sorts, the greater the productivity. Fewer sorts decrease costs and volume of logs in inventory. When considering additional sorts, the added benefits must offset added costs. The number of sorts also influences the choice of the best sorting system.

Number of Handling Operations

Extra handling decreases log-sort yard productivity and increases costs. Handling does nothing to add value to the products, so minimize handling, especially unnecessary picks; minimize handling of low-value material and handle in bunched loads to take advantage of log-handling equipment lifting capacity.

Log Storage

Log storage reduces productivity, increases costs, and increases log damage. Sometimes, there is no alternative to log storage; productivity would be lower and costs higher without storage. Yards with extreme variations in log input require log storage/surge areas to smooth out fluctuations in log yard flow. Yards with large storage areas have lower productivity than those with less storage area. Minimizing log inventory with short turnaround time helps reduce log yard costs and improves productivity.

Productivity vs. Log-Sort Yard Size

The area required for sorting logs increases with the volume sorted, the number of sorts, and the pieces processed per shift. Small log-sort yards with few sorts and minimal log storage have high machine productivity, the lowest capital investment per unit, and lower than average total costs per unit and piece. Large yards with many sorts and little log storage have the highest machine productivity, higher than average employee day productivity, the lowest total cost per unit and piece, and lower than average investment costs per unit.

Keys to a Successful Log-Sort Yard

A successful log-sort yard must meet its quality and productivity goals. One objective is to improve the productivity and quality of log sorting. At the same time, the log-sort yard must pay its way and be justified on a financial basis. Establishing a successful log-sort yard venture requires a well-conceived and researched business plan. Success also depends on a reliable source of raw material, product diversity, matching product to markets, and transportation infrastructure.

Business Plan

A business plan is essential to obtain financing and it greatly increases the odds of success. The plan starts with a well-executed marketing and financial feasibility analysis to identify viable log-sort yard opportunities. A business plan is generally required to secure venture capital. Factors to consider in developing a plan include the following (Davis 1996):

- Raw material — availability, price, location, quality, and mix
- Processing — technology, equipment, physical plant, automation, and manufacturing methods
- Products—mix, differentiation (e.g., competitively priced/quality), value-added
- Markets – share, competition, distance to markets, projected growth, niche vs. commodity
- Infrastructure—industrial and transportation infrastructures
- Community—business-friendly, workforce skills, work ethic, school system, quality of life
- Management and financing—*pro forma*, venture capital, fees, business taxes, incentives
- Safety/health/environmental—regulations and licensing

Reliable Source of Raw Material

Guarantee of consistent timber supply is the long-term overriding issue for establishing and maintaining a sustainable forest products industry. One primary objective of a log-sort yard is to facilitate mill log flow by providing a more consistent supply of the desired log supply. This means that the log-sort yard must also have a consistent supply of logs moving through its operations. Uncertainty of timber supply creates difficulties for the log-sort yard.

Log Product Diversity

The available log supply must have enough value in a diversity of log products from "camp run" logs. For example, there must be enough veneer peelers and high-quality sawlogs mixed with the pulpwood to financially warrant sorting the peelers and sawlogs from the pulpwood. A certain percentage of high-quality logs needs to be mixed in the general supply of logs available to the log-sort yard. A log-sort yard takes advantage of sorting efficiencies not possible at the log landing in the forest. Opportunity for a log-sort yard lies somewhere between having enough value in "camp run" logs and motivating the logger to sort logs at the landing.

Integrated Forest Products Industry — Matching Products to Markets

An integrated forest products industry, with the ability to utilize and market a variety of species and size classes, is key to a successful log-sort yard. Successful yards service a range of forest products businesses who use a variety of log products. Success is predicated on getting the most value from each log and getting it to the best available market. The log-sort yard opportunity is to provide a more stable wood supply of the right product mix to industry. Markets must also be matched with available timber resources.

Transportation Infrastructure

Distance to markets and lack of transportation infrastructure are barriers to success. Transportation infrastructure is a crucial consideration in siting a log-sort yard. Today, logs are being moved greater distances from forest to mill. Poor transportation infrastructure limits options to move products to market. Terminal facilities (such as truck and rail log-reload facilities) need to be identified and established to improve transportation of logs to market.

Concluding Remarks

Log-sort yards provide better utilization and marketing with improved value recovery of currently available timber resources in North America. Log-sort yards provide many services in utilization and marketing wood and fiber by concentrating, merchandising, sorting, and adding value to logs. Such operations supply forest products firms with a more desirable log mix suited to their operations. This can help the sawmill and plywood mill reduce the number of marginal logs processed in their operations, recover higher value per unit, and improve bottomline performance. Benefits of log-sort yards include the potential for more accurate grading, scaling, and sorting; the opportunity to merchandise logs into higher value products; and the opportunity to capture a higher value from otherwise lower grade "camp run" logs.

The goal of a log-sort yard is to improve the quality and productivity of log sorting and distribution through improved utilization and marketing. Ultimately, improvement results in better timber resource utilization and bottomline business performance. The objective of a log-sort yard is to maximize this return of the investment through improved log merchandising, grading, scaling, sorting, adding value, marketing, and distribution. When this objective is met, the log-sort yard achieves increased log value. Improved efficiency of grading, scaling, sorting, and adding value to log-sort and distribution functions produces cost savings and results in increased value per thousand board feet. Improved utilization and efficiency lead to improved productivity and quality in the forest products industry.

This is the first preliminary report by the authors on the subject of log-sort yards. The authors are also preparing a guidebook for developing and operating successful log-sort yard operations. The guidebook will cover many aspects of log-sort yards (e.g., layout and design, log processing and value-added operations, quality control, marketing). While this project is oriented toward the small log-sort yard to help timber-dependent rural communities recover from timber supply impacts, the information will have applications to larger commercial log-sort yard operations as well.

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