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Alaska Birch for Edge-Glued Panel Production—Considerations for Wood Products Manufacturers

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All photos by David Nicholls.

Abstract

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Edge-glued panels could become a natural extension for the birch (*Betula papyrifera* Marsh.) lumber industry in Alaska, resulting in greater utilization of the birch resource while allowing producers to explore a wider variety of products and markets. Key advantages of edge-glued panel production include the relatively low cost of equipment, the potential use of smaller diameter stems and less valuable grades of lumber, flexibility in panel product sizes, and opportunities to sell products within established local markets. This paper has reviewed practical considerations for wood products firms in Alaska who may be considering edge-glued panel production from birch lumber. Key issues could include equipment requirements, lumber drying, quality control considerations, wood machining, treatment of character mark features, marketing strategies, and strategic partnerships. Edge-glued panels represent a class of products that could be within the technical and financial reach of many Alaska producers. One immediate opportunity would be kitchen cabinet production; however, other products that utilize edge-glued panels include furniture, doors, and craft items.

Keywords: Alaska, birch, lumber, edge-glued panel, economic development.

Introduction

In Alaska, the birch (*Betula papyrifera* Marsh.) resource is extensive throughout parts of the interior and south-central regions of the state. However, relatively little birch is sawn into lumber, and much of this is sold into local markets for custom projects such as furniture, cabinets, or flooring. Alaska firms currently producing birch lumber are generally limited to random-width hardwood lumber, much of which is sold to customers at their mill sites. Production of edge-glued panels could become a natural extension for the birch lumber industry in Alaska, resulting in greater utilization of the birch resource while allowing producers to explore a wider variety of products and markets. Key advantages of edge-glued panel production include the relatively low cost of equipment, the potential use of smaller diameter stems, the use of less valuable grades of lumber, the flexibility in panel product sizes, and the opportunities to sell within established local markets.

Edge-glued panels represent a class of products that is likely to be within the technical and financial reach of many Alaska producers. Panels are created from narrow strips of lumber that are glued together under pressure. Because the finished products are often wider than standard lumber, they can provide applications that normal lumber could not meet. Edge-glued panels are versatile in that they can be manufactured for specific end uses (e.g., furniture, kitchen cabinets, or doors), or made as standard-sized blanks (fig. 1) (Bowyer et al. 1986). Because there is little specific information for Alaska producers on edge-glued panel manufacture, this paper will address some practical aspects of production and consider their unique challenges and strategies for success. It follows recent research that has considered Alaska birch use in retail lumber, cabinets, and craft products (Braden and Nicholls 2004, Donovan and Nicholls 2003, Nicholls et al. 2004). This research found generally high interest in birch products among retail managers and consumers in Alaska.

Figure 1—Edge-glued panels are often manufactured to standard dimensions. These pine panels include high levels of character such as knots and grain variation. (Photos by David Nicholls)

Throughout this paper, "panel" will refer to a finished glued-up assembly. "Strips" will refer to the individual pieces that are to be glued together along their edge grain. "Lumber" will refer to material that has been sawn from logs, but not yet processed into strips.

Birch Lumber Production in Alaska

An estimated 25 sawmills in Alaska have recently processed birch lumber (Parrent 2004). Current statewide annual birch lumber production is estimated to range from 100 to 250 thousand board feet (MBF). Several sawmills produce lumber only intermittently, with mills being idle part of the year, and some mills produce both hardwood and softwood lumber. At least 19 lumber dry kilns were in operation as of early 2005 (Nicholls et al. 2006); however, most kiln facilities (73 percent) dried primarily softwood lumber. Most hardwood sawmills are located in the Kenai Peninsula, south-central Alaska (including the Matanuska-Susitna valley), and interior Alaska (primarily in or near the Fairbanks-North Star Borough).

Objectives and Scope

This paper will consider some practical aspects of edge-glued panel production from Alaska birch, as well as identify potential barriers. It is intended as a practical resource for wood products producers; it is targeted toward those who already manufacture hardwood lumber or hardwood secondary products, and would be considering edge-glued panels as a new product line. However, results of this study should be of general interest to sawmill owners, secondary product manufacturers, and natural resource professionals interested in Alaska birch management and utilization. This paper is not intended as an economic analysis, engineering analysis, or business plan, nor does it claim that edge-glued panel production would necessarily become a profitable business venture for Alaska firms.

This paper addresses key issues for wood products producers in Alaska, including:

- Resource considerations
- Production process and equipment requirements
- Product yield and product types
- Quality control considerations
- Typical defects in edge-glued panels
- Wood machining and joint preparation
- Dimensional stability
- Wood color

- Wood strength
- Production levels
- Marketing considerations and strategies
- Strategic partnerships

Key Issues for Alaska Producers

Resource Considerations

Birch saw logs can be obtained from several sources in south-central and interior Alaska, including State of Alaska timber sales, land clearings associated with new development, and timber salvaged from fire or damaged by other deterioration agents. In interior Alaska, the Tanana State Forest has substantial birch resources, including more than 1.7 million acres of hardwood forests or spruce (*Picea*)/hardwood forests. Timber sale schedules are prepared by the State of Alaska Division of Forestry, outlining the division's plans for timber sales (Alaska Department of Natural Resources 2009). Actual harvests of birch timber in Alaska are difficult to quantify. Further, the distinction between birch fuelwood harvests and birch saw-log harvests are often unclear. During 2009, approximately 985,400 ft^3 of birch fuelwood sales were recorded in the Fairbanks area (Hanson 2009). In south-central Alaska, two recent timber sales (near Houston, Alaska) totaled 770 cords of birch fuelwood (Alaska Department of Natural Resources 2008). Although these harvests were designated as birch fuelwood, it is likely that they included some component of sawtimber-sized material that could be used to produce lumber for products such as edge-glued panels.

Municipal borough land holdings in Alaska can also provide timber for sawmills. In south-central Alaska, the Matanuska-Susitna region (commonly referred to as the "Mat-Su" region) is located roughly between Anchorage and Denali National Park and has forest stands capable of producing saw-log-sized birch. The Mat-Su Borough owns about 365,000 acres of land, of which 66,000 acres is classified as commercial forest land (RWS Consulting 2008). Recent urbanization within the Mat-Su region has resulted in land clearings for housing and other development. Removal of birch trees that span a range of diameters (including some of sawtimber size) provides an opportunity to use the resulting logs for value-added products, as opposed to hauling them to landfills.

Equipment Requirements

Many smaller wood products producers in Alaska that are producing lumber may already have much of the equipment needed to produce edge-glued panels. For low production levels, basic equipment needs could be achieved with the following:

- Sawmill for primary log breakdown
- Lumber dry kiln
- Planer
- Jointer
- Rip saw
- Chop (cross-cut) saw
- Glue-mixing and application equipment
- Clamp carrier or other clamping equipment
- Abrasive sander
- Banding and packaging equipment (if needed)
- Dry storage facility
- Moulder (not required, but could replace several equipment items above)

Several equipment combinations are possible from the list above. One producer indicates that very good results are achieved when producing groups of four large panels (up to 12 ft by 30 in) in batches, using stationary clamps, but without the need for automated clamp carriers (Poppert 2009). Other strategies could be used to allow firms to start producing panels with even simpler overall equipment requirements. For example, lumber could be purchased from outside vendors, eliminating the need for a sawmill and a dry kiln. Firms wishing to increase production levels of edge-glued panels could use this arrangement to produce exclusively panels (but not lumber).

For most firms already producing lumber, an important consideration (and possible learning curve) would be the addition of gluing and clamping equipment. Other important considerations would be whether to produce fixed-width versus variable-width strips, and what strip thickness would be optimal (i.e., could thinner strips be used for certain applications?). This decision could have implications for many later stages of the process, including stacking, sorting, and lay-up operations. Another aspect of the learning curve is that by producing new products such as edge-glued panels, firms have an opportunity to “become the customer.” That is, when they use material in a secondary process that they have already produced in a primary process (i.e., lumber), they can become aware of previously unrecognized quality issues.

Product Yield and Product Types

An important consideration for edge-glued panel producers will be the relative importance of panels versus other products in their portfolios (such as lumber, craft products, or energy products). A natural arrangement could be for wider and higher quality boards to be used for lumber, with narrower and lower grade boards (strips) for edge-glued panel production. Even smaller cuttings could be used for craft products or wood energy (along with sawdust and other residues). It is often desirable to limit the width of individual strips within edge-glued panels to a maximum of 3 in, as wider strips could be more likely to warp under changing moisture conditions. However, the use of many narrow strips in a glued panel results in greater glue use (and cost).

Another important consideration influencing yield would be whether lumber is ripped or cross-cut first. In high-production settings, lumber can be cross-cut to its longest usable length, and then further cut to one of 12 standard lengths (Araman and Hansen 1983). For smaller producers, fewer standard lengths would be recommended. Here, material could be processed first on a table saw (ripping), and then on a chop saw (cross-cutting), to achieve the desired length and width distribution. Simple guides and stops can be used with chop saws to ensure good length consistency for all material within a given length class. At higher production levels, finger-jointing equipment is commonly used to produce material to specific lengths with minimum waste. Accurate processing of lumber at this point (both width and length) will also help minimize trim losses after panels are glued.

Buehlmann et al. (1998, 1999) compared yields of red oak (*Quercus rubra* L.) lumber using computer simulations to evaluate “rip-first” versus “cross-cut-first” sawing strategies. Rip-first sawing resulted in generally greater yields than cross-cut first; however, significant differences were noted only when character marks less than 1-in diameter were considered.

Whether or not character-markings are included (versus clear wood only) in finished products has an important bearing on overall yield and value. For example, in one study that considered 2.782 MBF of birch lumber from Fairbanks and Anchorage, Alaska, the inclusion of small (0.5 in) character marks in lumber resulted in lumber value increases of $138 per MBF (Nicholls et al. 2004). Buehlmann et al. (1998) found that product yields were influenced by the size of the character marks allowed, the type of character, the grade distribution of the original lumber, and whether board grades are based on one or both faces. Here it is important for producers to understand customer needs—for example, whether panels will be used in applications where only one side is visible (i.e., certain types of furniture) versus panels having two appearance faces.

Quality Control Considerations

Quality control considerations are important during all phases of production including lumber processing, drying, gluing, panel trimming, and sanding. Several factors should be considered by manufacturers to ensure consistent quality of edge-glued panels.

Clamping pressure—
Clamping pressure is needed for close contact between wood surfaces and the glue. The optimal clamping pressure depends on wood density. Clamping pressures for birch (an intermediate density wood) would range from 150 to 200 pounds per square inch (psi). This is intermediate between high-density species (e.g., red oak) requiring 200 to 250 psi, and low-density species (e.g., spruce) needing only 100 to 150 psi (River and Okkonen 1991).

Glue consistency—
River and Okkonen (1991) identified several factors influencing bond formation in glued joints:

- Glue formulation (including molecular weight and solids content)
- Storage time of glue prior to use
- Spreading rate of glue on wood
- Air humidity in the gluing room
- Wood moisture content
- Temperature of both wood and air
- Assembly time

Wood moisture content—
Wood moisture content can have an important effect on gluing properties and on the dimensional stability of panels in service. It is important to kiln-dry all wood to a moisture content close to the end use conditions (6 to 8 percent moisture content is recommended for much of the United States [Forbes 1997]). However, in very cold, dry regions (such as interior Alaska) moisture contents of less than 6 percent might be needed to reduce or eliminate shrinkage.

Wood, glue, and air temperature—
The temperature of wood, glue, and air can influence glue curing times, and therefore it is important to follow glue manufacturer recommendations. In cold shops during winter, glue curing can take up to twice as long as during summer temperatures (The James L. Taylor Companies 2008). It is important to do all gluing at room temperature, allowing wood to first reach equilibrium moisture content (EMC). If lumber is stored outdoors, or in an unheated area, it should be

moved into a heated shop before gluing takes place (and sufficient time should be allowed for wood to reach room temperature). This could be especially important during winter production in interior Alaska, where temperatures below freezing are common.

Strip widths—
Use of narrower strips will help minimize cupping (which can be a problem when using wider pieces). A maximum strip width of 3 in is generally recommended; narrower (and thus more) strips means more glue lines and also greater glue expense. In practice, these two conditions would need to be balanced against one another.

Strips should be selected to minimize the amount lost in trimming to final size. For example, a wide strip should not be included along the edge of a panel if it will generate excessive waste during edge trimming. If possible, strip widths should be selected so that less than 0.125 in of trimming is necessary to reach the final panel width (Mitchell et al. 2005). However, in practice a trim allowance of greater than 0.125 in may be necessary.

Grain orientation of adjacent strips—
Adjacent strips should have growth rings oriented in opposite directions (i.e., rings cupped up versus rings cupped down). This way each strip will help restrain the one next to it if moisture changes are encountered.

Typical Defects in Edge-Glued Panels

Most defects in edge-glued panels can be classified as those related to moisture content changes, wood machining, or operator decisions. Defects can be detected either during processing or when products are in service. Typical defects are described here.

Delaminations—
Many times, delaminations can go unnoticed in fine-textured woods because failed surfaces can feel smooth to the touch (River and Okkonen 1991). If the wood becomes dryer while in service, it is possible for visible delaminations to form as the wood shrinks in response to lower moisture content. Conversely, strips having too high a moisture content can also lead to delaminations, as well as influencing the EMC of adjacent strips (Forbes 1997). Here, high moisture levels can interfere with the integrity of wood-glue bonds.

Wood loses or gains moisture about 10 to 15 times faster through the end grain versus face or edge grain. Therefore, dimensional change at the ends of strips may be more rapid than in the central portion, even for glued-up panels (River and

Okkonen 1991). These more rapid dimensional changes can lead to weak glue lines and possible delaminations at the exposed ends of strips in an edge-glued panel.

Cupping—

Cupping, or warping, can be caused when too much of the panel is composed of flat-sawn or quarter-sawn strips, and the panel experiences a moisture content change. The direction of annual rings should be alternated in adjacent strips to create a balanced panel construction (Mitchell et al. 2005). This way, the tendency for a given strip to cup in one direction could be offset (i.e., restrained) by an adjacent strip trying to cup in the opposite direction (fig. 2). Having individual strips that are too wide can also lead to cupping.

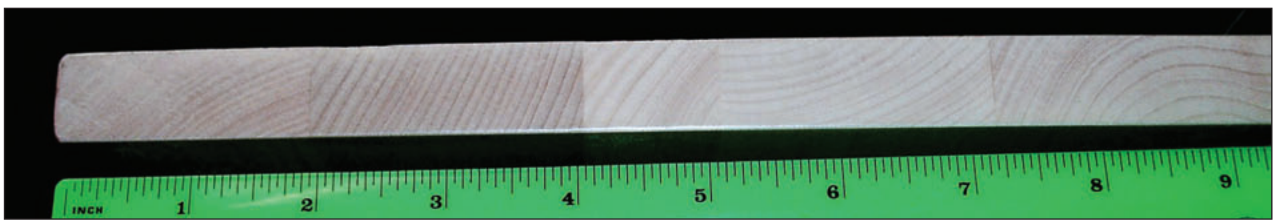

Figure 2—Panel warpage can be controlled when growth rings in adjacent strips are oriented in random directions, as seen in this edge-glued panel from birch.

Wood-related machining defects—

Dull sawblades can create several types of wood defects including (1) visibly burned wood surfaces (from excessive heat), (2) a smooth lustrous sheen, or (3) a fuzzy grain resulting from incomplete cutting of tension wood fibers (Mitchell et al. 2005).

Poor matching of color or grain—

This is an appearance defect caused when dissimilar strips are placed side by side in a panel (see “Wood Color” section). When color matching Alaska birch, one approach that could be used is to separate “brightwood” from the darker wood that is characterized by natural staining (fig. 3). Because the grain pattern in Alaska birch is typically less distinct than in some of the ring-porous hardwoods (e.g., red oak), sorting by grain would most likely not be a high priority.

Sunken glue joints—

“Sunken” glue joints can occur, primarily with water-based glues, when the wood near a glue line swells more than wood farther away. If the wood is planed in this condition, the eventual shrinkage near the glue line can result in a small “valley” or recessed area. A solution to this problem is to not machine wood immediately after gluing (but rather wait until the wood and glue equilibrate).

Figure 3—An edge-glued panel constructed from birch lumber containing knots and natural stain.

Sunken (or raised) strips—

When strips of different moisture contents are assembled into a panel, a sunken (or raised strip) can result. Here, individual strips can shrink or swell at different rates (in thickness) as a panel equilibrates, resulting in an uneven surface or rippled appearance. It is recommended that all strips be within about 2 percent moisture content of each other when glued (Mitchell et al. 2005).

Wood Machining and Joint Preparation

When producing edge-glued panels, uniformly square edges are critical to ensure good glue penetration and bonding. Although this can be accomplished using a production moulder, most Alaska producers could manufacture small amounts of high-quality material using a table saw or jointer. Regions of wood with lots of character marks or surface irregularities should be removed.

Poorly maintained equipment can create poor bonding surfaces. For example, dull or vibrating cutting tools can loosen wood fibers, leaving wood surfaces less receptive to glue (The James L. Taylor Companies 2008). When knives become worn and rounded off, they can beat down surface fibers, rather than cutting them cleanly. In extreme cases, wood can turn dark from burn marks, and glue penetration is inhibited.

Dimensional Stability

Dimensional stability of panels can be a concern if the EMC of wood when in use is different from the wood moisture content at the time of manufacture. Lumber for edge-glued panels used as furniture stock is typically maintained at 6 to 8 percent moisture content. In Alaska, an important consideration would be to match the final moisture of kiln-dried lumber with end-use conditions of panels (whether for in-state or export markets).

Shrink wrapping is often used for higher grades of edge-glued panels. Shrink wrapping is useful for protecting panels prior to use. However, this is a temporary barrier and would not be effective for reducing dimensional change in use (i.e., after shrink wrapping is removed). Panels that are manufactured at a relatively high moisture content, shrink wrapped, and then placed in service in arid climates could experience shrinkage.

Dimensional stability can also be influenced by the log size and the presence of juvenile wood. Serrano and Cassens (1998) found that dimensional change across the width of edge-glued panels was significantly higher for panels made from small-diameter logs (versus larger stems). However, from a practical standpoint, this difference amounted to less than 0.05 in. "Alaska paper birch" has published shrinkage values of 6.5 percent in the radial direction and 9.9 percent in the tangential direction (USDA FS 1999). Because these values are based on shrinkage from the green condition to oven-dry moisture, they represent the maximum amount of shrinkage possible. In practice, panels undergoing moisture content changes of just a few percent would experience much less shrinkage.

Wood Color

Color uniformity can have an important influence on product value in edge-glued panels, especially when light-colored woods are treated with natural finishes or light stains (Comers et al. 1996). A successful color-sorting system must be easy to use by plant personnel, must accurately classify parts by color class, and must keep up with plant production (Kline et al. 1997). Current trends have called for better color matching of individual laminates in panels, especially for export markets (Phelps et al. 1994). Both color and grain orientation have been identified as important appearance features in white oak (*Quercus alba* L.) dimension stock (Stokke et al. 1995). Other research in Anchorage and Fairbanks, Alaska, has indicated preferences for edge-glued panels or cabinet doors having wide variations in appearance, including features such as knots and natural stain (Donovan and Nicholls 2003).

Small producers in Alaska would likely not invest in automatic color-sorting systems. Therefore, it would be important to train one (or a few) operators to maintain consistent quality. One approach that could be used would be to use a visual preliminary sort into just two categories of strips (e.g., light color versus darker color) (Pugel et al. 1995). This would be followed by a secondary sorting step in which strips from a given color class (i.e., lighter or darker) would be laid-up into individual panels. This secondary sorting step would represent a “fine-tuning” step, so that color variation between individual strips in a panel would be minimized. It was recommended to include waist-high sorting tables and good lighting that includes a mixture of fluorescent and incandescent light (Pugel et al. 1995). Producers of Alaska birch could consider the above approach to sort strips by color, by character marks, by natural stain, or other features.

Another approach that could be used would be to segregate all strips from a given log, and then attempt to match individual strips together to form custom color patterns or grain patterns. Although this approach could be more time consuming (versus no sorting), small-diameter birch logs would generate relatively few strips to track. Recent market research in Fairbanks, Alaska, (Nicholls et al., n.d.) has shown that consumers can have strong preferences for birch panels having distinctive patterns of natural stain adjacent to clear wood. For markets like these, sorting step(s) could prove profitable.

Whether computerized or manual color sorting is used, both sides of a given strip should be inspected, and an appearance side assigned. Once this is done, it would be important to keep track of the appearance face throughout the manufacturing process. Optionally, strips could be assigned positions within panels (e.g., when a specific look is desired). This could be important when creating custom panels from Alaska birch that includes high levels of stain, knots, and other features (figs. 3 and 4).

Wood Strength

For most hardwood panels, appearance and not strength would likely be the most important consideration (e.g., kitchen cabinets). However, for other applications such as furniture stock, strength could be a consideration, and the final product design should take this into account. Clamping pressures ranging up to 150 psi are typical during resin curing (The James L. Taylor Companies 2008), and this pressure is well below the crushing strength of paper birch.[1] When gluing strips

[1] The Wood Handbook (USDA FS 1999) lists the compression strength perpendicular to the grain for clear paper birch wood at 12 percent moisture content to be 4,100 kilopascals (kPa), equivalent to 594.7 pounds per square inch (psi).

Figure 4—An edge-glued panel constructed from birch lumber containing knots as the primary character feature.

containing character features such as knots and bark pockets, it would be important to consider that their strength properties could be less than those of clear wood.

Production Levels

Edge-glued panels can be produced on a "factory scale," with one or two shifts per day, sophisticated gluing and clamping equipment, and initial investments of several million dollars. Deaver (2006) considered the economic feasibility of a plant producing 3.5 million board feet of panels per year in North Carolina, and concluded that this would be out of reach for most startup companies. Under certain designs, as much as 10 MBF of edge-glued blanks could be produced per 8-hour shift, with 38 full-time employees (Araman and Hansen 1983). By contrast, in Alaska, neither production capability nor statewide markets would likely justify this level of investment because most (if not all) birch sawmills are either sole proprietors or are family run. Resource availability and quality would also be considerations in determining plant capacity.

Most hardwood sawmills in Alaska operate on less than a full-time basis. Often, other activities, including timber harvesting, and even nonforestry activities (such as commercial fishing) occupy the mill owner's time. Further, many of these sawmills produce a combination of hardwood and softwood lumber. Therefore, the actual amount of hardwood lumber produced in a given year is typically considerably less than the rated sawmill capacity. An important question for these producers would be whether their production level would justify the investment in edge-gluing equipment (including gluing and clamping) as well as any wood processing equipment not already owned.

For Alaska producers of edge-glued panels, optimum production levels will likely depend on local markets, and on competing (or complementary) hardwood products produced by the same producers (or locally). This production level would most likely justify only a simple set of stationary clamps, or a small mechanized clamp carrier (but not more sophisticated arrangements).

Marketing Considerations

Marketing strategies will become an important part of panel producers' business plans. When developing effective marketing strategies, edge-glued panel producers should have a clear definition of their target markets, which takes into consideration potential customers, appearance attributes of products, preferred sales outlets, and transportation distances.

Character-Marked Woods

An important consideration for birch panels will be the use of character-marked wood (i.e., lumber containing small knots, bark pockets, natural stain, and other features not found in clear wood). Birch lumber inventories were evaluated at four sawmills in Fairbanks and Wasilla, Alaska. According to National Hardwood Lumber Association (NHLA) rules, only 4.7 percent was in high-grade lumber (Select grade or better), with the remaining lumber falling within the Common grades (Nicholls et al. 2004). Therefore, producers who wish to fully utilize their birch lumber when producing panels would need to include character-marked features (and be able to successfully market panels with this "look"). In a separate study, 600 birch trees from Alaska's Susitna River Valley were dissected, and it was found that 90 percent contained some decay and virtually all trees included at least some natural stain (Trummer 2001). Character mark features common to Alaska birch include regions of knots (fig. 4), natural stain (figs. 3, 5, 6, and 7), heartrot (fig. 7), and decay (fig. 7), a condition that often results in a spalted[2] appearance.

[2] Spalting is caused by certain white-rot decay fungi found primarily in hardwoods (including birch) and can result in decorative patterns. The fungi create distinctive zone lines in the wood as well as unusual colorations and multicolored streaks. In some cases, spalting can diminish wood strength (USDA FS 2004).

Figure 5—Sawn birch lumber, with regions of natural stain evident on end grain.

Figure 6—Alaska birch lumber is often characterized by high levels of character, such as this stack of kiln-dried, planed lumber at a retail sales outlet.

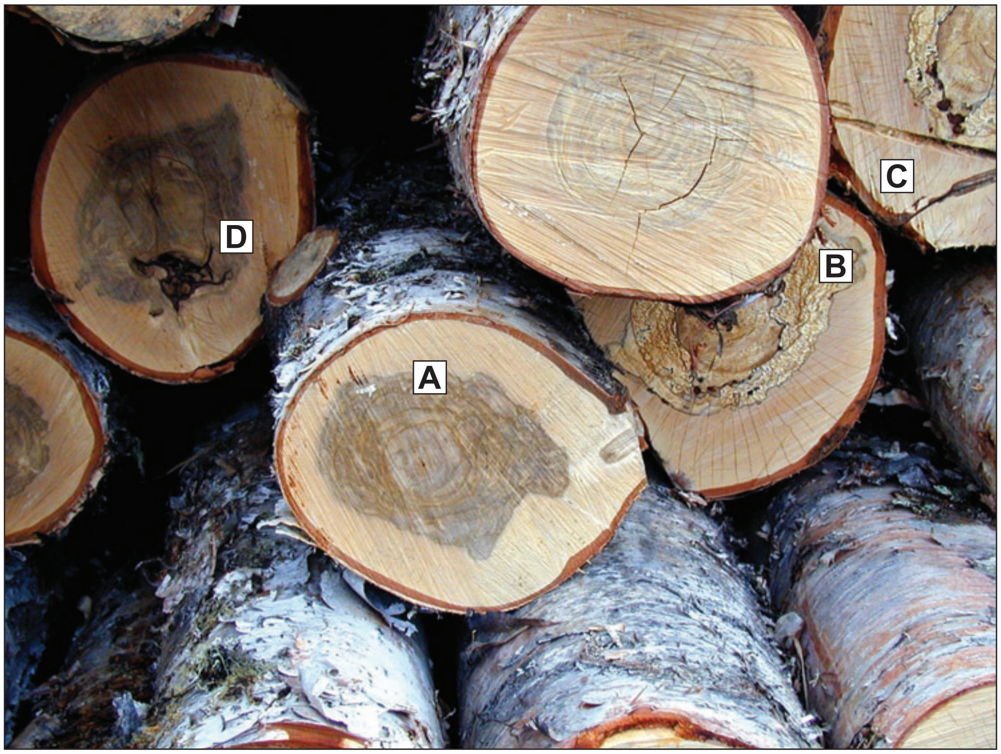

Figure 7—Birch stems can be characterized by regions of (A) natural stain, (B) decay, (C) checking and splitting, and (D) bark pockets. Although these features can add to the natural character of this wood, they can also reduce lumber recovery.

Character-marked birch panels featuring natural stain and knots have demonstrated strong appeal among some homeowners (Nicholls et al., n.d.). The panel shown in figure 3 was preferred by a wide margin among home show attendees in Fairbanks, Alaska. Many respondents commented on how the natural stain formed a striped pattern, often described as a "hickory look." Thus, one strategy for Alaska producers would be to emulate more popular (or valuable) species in edge-glued panel construction.

Paint-Grade Versus Stain-Grade Panels

Lower grades of wood could be used for paint-grade panels. Here, the original appearance would be completely covered, and as long as the wood surface is smooth and integral, consumers would not be able to discern use of lower grade wood.

By contrast, higher grades of wood could be used for stain-grade panels. Here, the wood would be treated with a stain or clear coat finish for its end use. Depending on the type of stain used, character marks and other features would still be discernable. Past research on red alder (*Alnus rubra* Bong.) edge-glued panels (constructed as kitchen cabinets) found the darkness or lightness of stain can have a strong influence on consumer preferences (Nicholls and Roos 2006).

Potential Niche Markets

Niche marketing is a "method for reducing competition and gaining more control over product prices" (Smith et al. 2008). Because there is less competition within niche markets, the demand for niche products is less elastic, and producers can become "price makers." If the producer raises prices there will be a less-than-proportional fall in the quantity demanded, the result being an increase in total revenues.

Smith et al. (2008) identified four major factors to consider when entering niche markets: (1) customer perceptions, (2) effect on manufacturing, (3) commitment, and (4) markets and marketing. Therefore, an important decision for panel producers in Alaska would be whether to produce and market standard edge-glued blanks versus "niche" products to serve specialized markets and customers. Examples of niche products could include kitchen cabinets, cutting boards (fig. 8), tabletop rounds (fig. 9), stair treads (fig. 10), countertops, and even gift products.

Figure 8—Edge-glued Alaska birch can be used to make craft products, such as this cutting board. Character-mark features visible above include a thin region of natural stain, a knot, and grain variation.

Figure 9—Tabletops can be made from edge-glued panels, and at least one major wood products firm markets these items nationally.

Figure 10—Stair treads are a high-value product that can include edge-glued lumber. Above, oak edge-glued laminates are enclosed in thin veneers, which form the top and bottom surfaces.

Several examples of successful niche markets for edge-glued products are noted for national and for Alaska markets.

Plum Creek Timber[3]**—**

Edge-glued products include paint-grade panels, stain-grade panels, and tabletop rounds (Plum Creek 2009) (fig. 9). Higher grades of panels (i.e., stain grade) are often shrink wrapped, and are free of finger joints. These panels are identified as being suitable for fine furniture applications. Lower grades of wood are often used to produce panels that are not shrink wrapped, and may include finger joints. These panels are identified as being suitable for crafts and construction projects.

Poppert Milling (Wasilla, Alaska)—

This firm produces custom edge-glued panels from birch lumber sawn onsite. Two classes of products are made: stair treads and glu-lam "beam-wraps." Beam wraps are edge-glued products that are attached to glu-lam beams in interior applications for aesthetic reasons (i.e., they are appearance products only).

Five steps have been identified for wood products producers to consider in identifying niche opportunities (Smith et al. 2008):

1. Analyze the existing market.
2. Identify neglected or underserved market segments.
3. Evaluate your strengths in serving identified segments.
4. Select the niche where you have a competitive advantage.
5. Develop a marketing program to meet the needs of this market.

For higher value products (e.g., appearance grade birch), producers would need to accurately identify and define their niche to avoid direct competition with lower value products (e.g., paint grade western pines (*Pinus*)). Bush et al. (1991) identified the tendency of smaller firms to be production oriented with only limited relations with end users. These firms might not be fully aware of consumer preferences, and thus an "extra effort" is required to accurately define their target markets (including niche markets). If firms are successful at entering and establishing niche markets, then competition will soon follow from other producers (Smith et al. 2008) (i.e., a good idea will not be kept a secret for very long).

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[3] The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

Strategic Partnerships

An important aspect of successful marketing of edge-glued panels will be developing partnerships with other businesses involved in the entire supply chain. This group could include retailers, distributors, architects, builders, and secondary wood products producers.

A key relationship would be with retail sales managers. Several Alaska retail lumber managers have expressed a general interest in carrying birch lumber products but stressed the need for a reliable lumber supply (Nicholls 2001). Other retailers in Alaska indicated generally strong interest in carrying birch edge-glued panels having various levels of character marks, and favored larger panel sizes (Nicholls et al. 2010). Brinberg et al. (2007) also found that retailers and consumers can value character-marked lumber differently when used in furniture production.

Edge-glued panels could be produced as dimension stock and then sold to producers of furniture, stair treads, and other products utilizing edge-glued construction. As of the mid-1990s, it was estimated that more than 16 percent of dimension lumber was manufactured into edge-glued panels (Smith and Araman 1997). Alternatively, edge-glued panels could be sold in standard sizes for home hobbyists (i.e., "do-it-yourselfers"). Panels would be manufactured to a set number of standard sizes, and sold at lumber yards and home improvement centers (Bowyer et al. 1986). Product location, type of display, and whether to shrink-wrap package the panels would be important considerations. Again, the relationship with retail store managers would be of primary importance.

Discussion and Considerations

This paper considers production of edge-glued panels as an opportunity for wood products firms in Alaska. Important considerations include the scale of operation, equipment needs, proper moisture content control, transportation distances, and identification of appropriate niche markets. An easily overlooked, yet potentially important consideration, would be for heated space for production facilities, especially during winter months.

Edge-glued panels could become a profitable product line for sawmills already processing hardwood lumber that have identified local markets. In some cases, edge-glued panels could be substituted for random-width hardwood lumber. Where other forest products industries are present (i.e., pellet mills, sawmills, or secondary processing firms), edge-glued panel production could experience a synergistic effect when becoming part of a local wood products "cluster." A cluster can be thought of as a critical mass of companies in a particular location (Porter 1990, as referenced in Rojas 2007). In general, greater local forest products activity could bode well for edge-glued panel producers, as it would likely increase their options for buying logs or lumber, selling wood waste, or finding markets for slabs and edgings. Plans for a wood pellet production facility near Fairbanks, Alaska, have been announced (Mowry 2009), but as of 2009, this plant was not yet operating.

Kitchen cabinets (fig. 11) represent the best near-term market for edge-glued panel producers for most Alaska markets. They are relatively easy to produce (compared to most furniture products), and their small size is favorable for shipping. Narrow board widths in cabinets would be conducive to using small-diameter birch logs. Local markets are already well developed in Alaska's larger cities including Anchorage, Fairbanks, Juneau, and the northern Kenai Peninsula. There is a strong overall interest in character-marked birch cabinets, as demonstrated by consumer preference research in several Alaska markets. Ultimately, it would be up to each wood products firm to evaluate the specific resources, production needs, and markets that they would serve.

Figure 11—A kitchen cabinet constructed from edge-glued Alaska birch, featuring bark pockets and natural stain.

Glossary

board foot—A piece of lumber that is 1 ft wide, 1 ft long, and 1 in thick, or its volumetric equivalent.

cup (or cupping)—A form of board warp in which there is a deviation from a straight line across the width (McMillen and Wengert 1978).

equilibrium moisture content (EMC)—The moisture content at which wood neither gains nor loses moisture when surrounded by air at a given relative humidity and temperature. It is frequently used to indicate potential of an atmosphere to bring wood to a specific moisture content during a drying operation (McMillen and Wengert 1978).

finger joint—An end joint made up of several meshing wedges or fingers of wood bonded together with an adhesive. Fingers are sloped and may be cut parallel to either the wide or narrow face of the piece (USDA FS 1999).

flat-sawn lumber—Lumber that has been sawn parallel to the pith and approximately tangent to the growth rings. Lumber is considered flat grained when the annual growth rings make an angle of less than 45° with the surface of the piece (USDA FS 1999).

lumber dry kiln—A chamber having controlled air flow, temperature, and relative humidity for drying lumber. The temperature is increased as drying progresses, and the relative humidity is decreased (USDA FS 1999).

planer—A piece of sawmill equipment that planes rough lumber, leaving it smooth and uniform in size.

quarter-sawn lumber (or edge-grained lumber)—Lumber that has been sawed so that the wide surfaces extend approximately at right angles to the annual growth rings. Lumber is considered edge grained when the rings form an angle of 45° to 90° with the wide surface of the piece (USDA FS 1999).

rip—To cut lengthwise, parallel to the grain (USDA FS 1999).

stain—A discoloration in wood that may be caused by such diverse agencies as micro-organisms, metal, or chemicals. The term also applies to materials used to impart color to wood (USDA FS 1999).

Metric Equivalents

When you know:	Multiply by:	To find:
Inches (in)	2.54	Centimeters
Feet (ft)	.3048	Meters
Cubic feet (ft^3)	.0283	Cubic meters
Pounds per square inch (psi)	6.8947	Kilopascals
Acres	.405	Hectares
Board feet, lumber scale	.0024	Cubic meters, lumber

References

Alaska Department of Natural Resources, Division of Forestry. 2008. Annual Report 2008. http://forestry.alaska.gov/pdfs/2008AnnualReport.pdf. (21 October 2009).

Alaska Department of Natural Resources, Division of Forestry. 2009. Five year schedule of timber sales. http://forestry.alaska.gov/timber/fiveyearschedules.htm. (23 September 2009).

Araman, P.A.; Hansen, B.G. 1983. Conventional processing of standard-size edge-glued blanks for furniture and cabinet parts: a feasibility study. Res. Pap. NE-524. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 11 p.

Bowyer, J.L.; Kallio, E.; Monson, C.R.; Nicholls, D.L. 1986. Standard blanks: a new alternative to hardwood lumber. Forest Products Journal. 36(2): 67–73.

Braden, R.; Nicholls, D.L. 2004. Alaska birch crafts and gifts: marketing practices and demographics. Forest Products Journal. 54(9): 25–27.

Brinberg, D.; Bumgardner, M.; Daniloski, K. 2007. Understanding perception of wood household furniture: application of a policy capturing approach. Forest Products Journal. 57(7/8): 21–26.

Buehlmann, U.; Wiedenbeck, J.K.; Kline, D.E. 1998. Character-marked furniture: potential for lumber yield increase in rip-first rough mills. Forest Products Journal. 48(4): 43–50.

Buehlmann, U.; Wiedenbeck, J.K.; Kline, D.E. 1999. Character-marked furniture: potential for lumber yield increase in crosscut-first rough mills. Forest Products Journal. 49(2): 65–72.

Bush, R.J.; Sinclair, S.A.; Araman, P.A. 1991. A qualitative investigation of competition in the U.S. hardwood lumber industry. Forest Products Journal. 41(11/12): 43–49.

Comers, R.W.; Kline, D.E.; Araman, P.A. 1996. Automatic color sorting system for hardwood edge-glued panel parts. In: Proceedings of CIFAC ’96 international symposium, High Point, North Carolina, U.S.A. Berkeley, CA: Wood Machining Institute: 115–120.

Deaver, M.E. 2006. Economic feasibility of a solid hardwood panel manufacturing enterprise. Raleigh, NC: North Carolina State University. 193 p. M.S. thesis.

Donovan, G.; Nicholls, D.L. 2003. Consumer preferences and willingness to pay for character-marked cabinets from Alaska birch. Forest Products Journal. 53(11/12): 27–32.

Forbes, C.L. 1997. Quality control for edge glued panel manufacturing. Wood Products Notes. North Carolina State University. http://www.ces.ncsu.edu/nreos/wood/wpn/quality_panel.htm. (23 September 2009).

Hanson, D. 2009. Personal communication. Statewide Inventory Forester, Northern Regional Office, Alaska Division of Forestry, 3700 Airport Way, Fairbanks, AK 99709.

Kline, D.E.; Conners, R.W.; Lu, Q.; Araman, P.A. 1997. Automatic color sorting of edge-glued panel parts. In: Meyer, D.A., ed. Proceedings of the 25th annual hardwood symposium: 25 years of hardwood silviculture: a look back and a look ahead. Memphis, TN: National Hardwood Lumber Association: 161–166.

McMillen, J.M.; Wengert, E.M. 1978. Drying eastern hardwood lumber. Agric. Handb. 528. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 104 p.

Mitchell, P.H.; Wiedenbeck, J.; Ammerman, B. 2005. Rough mill improvement guide for managers and supervisors. Gen. Tech. Rep. NE-329. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 60 p.

Mowry, T. 2009. Wood pellet manufacturing plant planned for Fairbanks. Fairbanks Daily News-Miner. February 2. On file with: D. Nicholls.

Nicholls, D.L. 2001. An evaluation of the retail market potential for locally produced paper birch lumber in Alaska. Gen. Tech. Rep. PNW-GTR-493. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 27 p.

Nicholls, D.L.; Brackley, A.M.; Rojas, T.D. 2006. Alaska's lumber-drying industry—impacts from a federal grant program. Gen. Tech. Rep. PNW-GTR-683. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 23 p.

Nicholls, D.L.; Bumgardner, M.; Barber, V. [N.d.]. Consumer and manufacturer perceptions of edge-glued panels made from Alaskan hardwoods. Manuscript in preparation. On file with: D. Nicholls.

Nicholls, D.L.; Bumgardner, M.; Barber, V. 2010. Edge-glued panels from Alaska hardwoods: retail manager perspectives. Gen. Tech. Rep. PNW-GTR-809. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 14 p.

Nicholls, D.L.; Parrent, D.; Pavia, K. 2004. Investigating the potential for developing alternate grading rules for Alaska birch lumber. Forest Products Journal. 54(2): 57–60.

Nicholls, D.L.; Roos, J. 2006. Red alder kitchen cabinets—How does application of commercial stains influence customer choice? Res. Note PNW-RN-556. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 9 p.

Parrent, D. 2004. Alaska wood products manufacturers directory. Sitka, AK: Juneau Economic Development Council, Wood Products Conservation and Development. 74 p.

Phelps, J.E.; Stokke, D.D.; Pugel, A.D. 1994. Color analysis of white oak, edge-glued furniture panel stock. Forest Products Journal. 44(2): 35–38.

Plum Creek. 2009. Edge glued panels and rounds. http://www.plumcreek.com/Portals/0/downloads/productInfo/edgegluedpanels.pdf. (28 September 2009).

Poppert, D. 2009. Personal communication. Owner, Poppert Milling, Inc., P.O. Box 870051, Wasilla, AK 99687.

Porter, M. 1990. The competitive advantage of nations. New York: Free Press. 855 p.

Pugel, A.D.; Phelps, J.E.; Stokke, D.D. 1995. Improving visual color sorting of dimension stock. Forest Products Journal. 45(11/12): 57–60.

River, B.H.; Okkonen, E.A. 1991. Delamination of edge-glued wood panels: moisture effects. Res. Note FPL-RN-0259. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 13 p.

Rojas, T.D. 2007. National forest economic clusters: a new model for assessing national-forest-based natural resources products and services. Gen. Tech. Rep. PNW-GTR-703. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 40 p.

RWS Consulting. 2008. Matanuska-Susitna Borough forest management plan—phase 1, part 1. http://ww1.matsugov.us/CommunityDevelopment/index.php?option=com_content&view=article&id=237&Itemid=299. 21 p. (23 September 2009).

Serrano, J.R.; Cassens, D. 1998. Dimensional stability of red oak panels produced from small-diameter top logs. Forest Products Journal. 48(7/8): 71–74.

Smith, B.; Araman, P. 1997. Exploring value-added options—edge-glued panels and blanks offer value-added opportunities. Southern Lumberman. 258(4): 42–43.

Smith, R.L.; Cesa, E.T.; Rappold, P.M. 2008. A marketing guide for small and medium sized primary forest products processors. NA-TP-02-07CD. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 92 p.

Stokke, D.D.; Pugel, A.D.; Phelps, J.E. 1995. Variation in lightness of white oak dimension stock. Forest Products Journal. 45(10): 51–56.

The James L. Taylor Companies. 2008. The book on gluing. Poughkeepsie, NY. 20 p. http://www.jamesltaylor3.com/about/about_gluing.php. (23 September 2009).

Trummer, L. 2001. Assessment of stain and decay in paper birch, Point Mackenzie, Alaska: an interim report. Biological Evaluation R10-TP-106. Anchorage, AK: U.S. Department of Agriculture, Forest Service, Alaska Region, State and Private Forestry, Forest Health Protection. 11 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 1999. The wood handbook: wood as an engineering material. Gen. Tech. Rep. FPL-GTR-113. Madison, WI: Forest Products Laboratory. 463 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2004. Producing spalted wood. MO-1. Madison, WI: Forest Products Laboratory. 2 p. http://www.fpl.fs.fed.us/documnts/techline/producing-spalted-wood.pdf. (23 September 2009).

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