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WOOD PRODUCTS TECHNOLOGY TRENDS

Changing the Face of Forestry

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TO A GREAT EXTENT, forest products technology changes in response to changing costs, market conditions, and availability or scarcity of forest resources. In the future, technologies will continue to adapt as the types of raw materials from forests become more diverse. Technology will also seek to use wood and fiber from other sources, such as recyclable materials. A number of key developments in structural wood products technologies, as well as pulp and paper technologies, are already changing the wood manufacturing process and affecting how timber is used.

Resource Scarcity and Timber-Use Trends

Concerns about resource scarcity pepper the history of timber use in the United States. Recently, the President's plan for protecting spotted-owl habitat and old-growth ecosystems was implemented in the Pacific Northwest region of the United States (FEMAT 1993). This action was one of many that resulted in significant reductions in availability of timber for harvest on federal lands. From its historical peak in 1987, federal timber harvest nationwide has dropped by more than 50 percent to a post World War II low of less than 1 billion cubic feet (28 million cubic meters). While timber supply was constrained, demand for wood products continued to grow, as did commercial timber harvest in the United States. By 1995, around 95 percent of US timber harvest was derived from nonfederal timberlands. The story of how timber markets and technology respond to scarcity provides an interesting account of human and natural resource interactions.

Assessment of current timber supply and demand confirms that some timber resources are indeed becoming more scarce. For example, softwood sawtimber stumpage prices have increased as a result of limited supplies and increased demand (Haynes et al. 1995). As a result, technology and markets have shifted away from production processes that rely on larger diameter softwood timber species, such as softwood plywood. Current technologies can use smaller diameter timber and hardwood species to develop wood products, such as oriented strandboard (OSB).

The relative scarcity or abundance of fiber resources has also been an important driver of material substitution in the pulp and paper sector. When massive increases in paper collection and recovery efforts created a glut in wastepaper markets from 1989 to 1994, the US paper industry responded by substantially increasing the level of paper recycling. As a result, recycled fiber use shifted from around one-fourth to roughly one-third of total fiber use (the remaining two-thirds was still derived from pulpwood). As the wastepaper glut ended in 1994 amid skyrocketing prices and scarcity of recycled fiber, growth in recycled fiber use slowed down and was exceeded once again by growth in the use of virgin wood pulp. Growing demand for wood pulp and increased production of OSB could contribute to relative scarcity (higher prices) for pulpwood in the years ahead, which may lead to further technological responses. In general, relative scarcity or abundance of wood and fiber resources plays a significant role in determining timber use trends through the response of markets and technology (Ince et al. 1995).

Fiber Resources

Alternative technologies allow the use and substitution of different materials from the forest resource. With new technologies, more products can be made efficiently from smaller or lower grades of timber or alternative sources of fiber, yet still meet conventional performance, strength, or quality requirements. If wood is to be grown for pulp or strands for composite products, then the best management practice may be to maximize volume of fiber produced per unit of time. However, volume maximization may not produce the best physical properties for some engineered wood products, furniture, and paneling (Spelter et al. 1988).

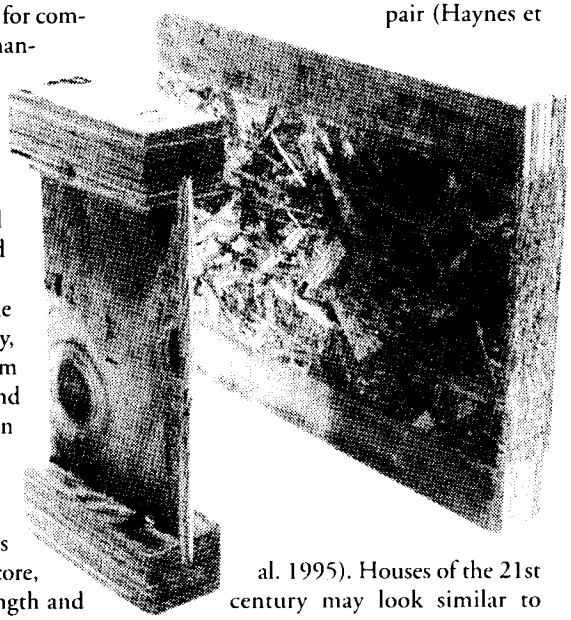
According to researchers at the USDA Forest Products Laboratory, higher strength lumber comes from trees that grow slowly at first and quickly later. This growth pattern maximizes the volume in the outer growth rings, where the wood is stronger and more desirable for lumber, and minimizes the volume in the juvenile wood core, where the wood is lower in strength and prone to warp. However, distinctions of diameter and strength are not as important in engineered wood products such as oriented strandboard, which are being successfully substituted for conventional wood products.

Recycled materials offer an additional source of fiber for alternative wood products. Composite products in particular could be made from recycled solid wood. In 1993, an estimated 38 million metric tons of unrecovered wood waste might have been recoverable for products (McKeever 1995). A particleboard plant in Eugene, Oregon, obtains up to half its furnish from construction waste, pallets, crating, and other sources. A Chicago entrepreneur has explored establishing a small, medium-density fiberboard plant that uses demolition wood and construction waste as a raw material.

In the future, as more forests are managed under ecosystem management principles, they will produce wood of varying size and quality. Future wood and paper products technologies will continue to adapt to this wider range of raw materials. In addition, technologies for sorting and classifying materials are likely to become more advanced.

Trends in Building Materials

Wood continues to be a major resource for housing and construction materials. In 1992, almost two-thirds of lumber and structural wood panels consumed in the United States were being used for new housing construction or for housing alteration and repair (Haynes et al. 1995). Houses of the 21st century may look similar to those of today, but they are likely to use wood materials that differ substantially from traditional materials.



in just 15 years, oriented strandboard has become a competitive substitute for softwood plywood in construction (Spelter 1988), where it now satisfies about one-third of the structural wood panel market ***(fig.*** 1). Because OSB is a composite made with small wooden strands, OSB manufacturing technology is much less dependent on larger diameter logs or select

Above: Engineered wood products can be designed to fit the strength and configuration neededfor a particular application. Opposite: Paper and paperboardproducts will account for about 40 percent of municipal solid waste in the year 2000. Recovery and recycling of waste has a major effect on the pulp and paper industry.

species than is the technology for other composite products. As such, OSB technology has provided a means for using previously underused, small-diameter hardwood species.

Parallel chord trusses (made with small-dimension lumber) and wood I-joists (made with OSB components) have also replaced large-dimension lumber in many uses (Moody and Collet 1988). For example, I-joists are now used for 17 percent of floor area in US residential construction (The Engineered Wood Association 1995). Laminated strand lumber—created by reducing logs to 12-inch (305 -rent) strands, then aligning the strands and pressing them together—is being used for headers, core material in windows and doors, And specialty millwork (Ryan 1993).

An advantage of these engineered wood products over conventional lumber is that they can be designed to fit the strength and configuration requirements for a particular application. Engineered wood I-joists, for example, are designed to conserve wood resources by concentrating wood fiber where the greatest strength and stiffness are needed. Moreover, engineered wood products are generally lighter than solid wood products for the same use.

Future engineered wood products are also likely to be manufactured from underused wood, such as abundant hardwoods and small-dimension softwoods (Moody and Collet 1992). Researchers are investigating the use of low-density hardwoods, such as red maple and yellow poplar, for use in structural glued-laminated timber.

Composite products made from the combination of wood and nonwood materials may also play a greater role in the future. Composite materials that combine wood with plastic, cement, or other inorganic materials provide an opportunity to create new building systems, such as those in which wall panels support the load of the structure. Such composites could be molded into continuous corners or trusses. Structural applications of these materials, however, are challenged by potential safety implications.

Another market for wood-nonwood composites is likely to be in the area of filled plastics. These products may be used for many applications in which conventional plastic materials are used, not just in construction. According to the Society of the Plastics Industry, Inc., the United States produced 4.8 billion pounds (2 million metric tons) of thermoplastic products in 1992. A portion of the expensive plastic resin in these products could be replaced by cheaper wood fiber. As US wood use approaches several hundred million metric tons per year, a relatively modest use of wood could significantly extend the production of composite products made with plastic.

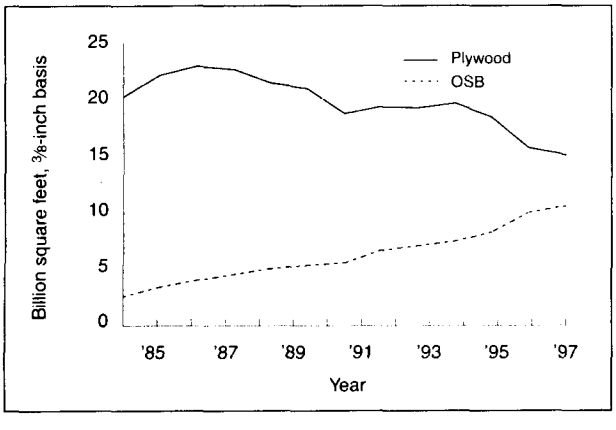


Figure 1 (above). US softwood plywood and OSB production, 1985–1994, with projections to 1997. Source: The Engineered Wood Association 1995.

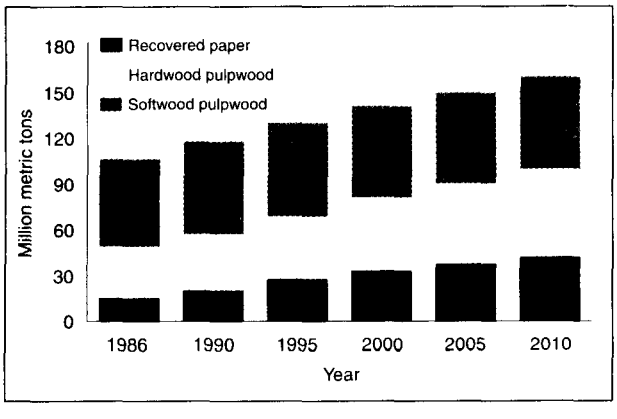


Figure 2 (right). US pulpwood and recovered paper consumption, 1986–1994, with projections to 2010. Source: Haynes et al. 1995.

Trends in Pulp and Paper

In the pulp and paper sector, some important technological changes can be traced to relative scarcity or abundance of fiber resources. For example, technological adjustments have allowed hardwood pulpwood to gain an increasing share of total pulpwood consumption in recent decades, partly because hardwood is generally cheaper than softwood in the United States. Other incentives for change include increased demand for recycled paper and paperboard products, consumers' increased environmental concerns, capital-cost and operating-cost advantages of alternative manufacturing processes over traditional ones, and a growing demand for paper products.

Recovery and use of recyclable paper increased substantially in the early 1990s. Recyclable paper use is projected to increase from less than 25 percent in the late 1980s to 40 percent by the year 2000, and then climb gradually to around 45 percent toward the middle of the next century (Ince 1994a). Projections indicate that the most rapid gains in recycling will have occurred by the early 1990s, and that recycling should increase at a much slower pace as the wastepaper glut ends in the mid- 1990s. Consequently, pulpwood consumption is likely to continue to increase along with increased use of recycled fiber ***(fig, 2).***

Recycling and recovery of paper have been promoted by government regulation and by consumer preference for recycled products. President Clinton's executive order of 1993 requiring minimum recycled paper content in uncoated printing and writing paper purchased by the federal government has been accompanied by similar state and local government agency standards. As of January 1994, 40 states had set various recycling goals, 18 states had provided tax incentives for manufacturers to use recovered paper materials, and all but one state had outlined recycled content procurement guidelines for state agencies (Alig 1994).

The trends in recycling and recovery of waste paper are indirect effects of the waste disposal crisis. Paper and paperboard products are expected to account for approximately 40 percent of municipal solid waste (MSW) by the year 2000 (Recycled Paper News 1995). Local and national opposition to expanding landfills has resulted in public regulation of solid wrote disposal. Diversion of wastepaper from landfills to recycling plants has provided some relief to MSW landfills and greatly enhanced the supply of recovered paper for

recycling in the early 1990s.

New de-inking processes, improved drying techniques, and cost-efficient sorting technologies have improved production efficiency and quality of paper products made from recycled materials. Projections of trends in newsprint technology indicate that processes using recycled furnish (either 100% old newspapers by means of the washing/de-inking process, or 30% coated mixed paper and 70% old newspaper through the flotation/de-inking process) will account for most of the growth in North American newsprint production during this decade (Ince 1994b). With improved pressing and drying processes yieiding higher sheet strength in linerboard, mills now routinely use up to 30 percent recycled fiber from old corrugated containers when mixed with kraft pulp in the production of linerboard for corrugated boxes (Ince 1994b).

Most shifts from one technology to another are also linked by a common thread of increasing product demand. Current consumption of paper and paperboard in the United States is more than 700 pounds (320 kilograms) per capita annually. Consumption is expected to increase more or less steadily over the next 30 to 40 years at an average annual rate of 1 to 2 percent (Ince 1994a). The pulp and paper sector will continue to make technological changes in response to consumer preferences for recycled paper and paperboard products and to the general concern that industry should make efficient use of natural resources.

Conclusion

Wood and paper products technologies ate changing in response to the availability of forest resources and environmental concerns. Development and use of new manufacturing methods and products and the growth of recycling technology will facilitate use of changing quantities, qualities, and sources of wood fiber. Future technologies will not only adapt to a greater variety of forest raw materials, but will also seek to use wood and fiber from other sources such as recyclable materials. Although future technologies will allow us to make use of untapped forest resources and reduce the strain on overexploited ones, matching wood processing technologies to tree species will continue to be a challenge for foresters and forest product manufacturers. JOF

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