



Mississippi Forest Products Laboratory RESEARCH ADVANCES

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FURNITURE RESEARCH: KEY TO THE FUTURE OF THE INDUSTRY IN MISSISSIPPI

In 1987 the Mississippi Legislature authorized the establishment of a Furniture Research Unit at the Mississippi Forest Products Laboratory. Its purpose? Provide technical assistance to the Mississippi furniture industry. This technical assistance encompasses both research and consultation targeting the development of:

- a better understanding of available wood resources;
- improved machining methods;
- computer software to improve manufacturing efficiency and productivity;
- improved test methodology for quality control; and
- improved marketing strategies.

Evaluation of the program after five years indicates that it has been a wise investment by the State of Mississippi. Efforts by our team of dedicated scientists have been extremely valuable to this industry. Annual savings to the industry already exceed three times the cost of the program. Additional savings will be forthcoming as this research program matures. It is estimated that the overall benefits will exceed four times the cost of the program annually over the next five years. More importantly, this work contributes significantly to the future growth and prosperity of this vital industry.

According to the Tennessee Valley Authority, the forest products industry is vitally important to Mississippi's economy. The forest products industry employs 61,000 people with an annual payroll of \$1.2 billion. One in four manufacturing jobs in the State is related to the forest products industry.

While the industry provides employment and local markets for timber, many challenges remain. While increased world demand for **timber raw materials** benefits Mississippi's timberland owners, it increases material prices to local factories, threatening profitability and employment.



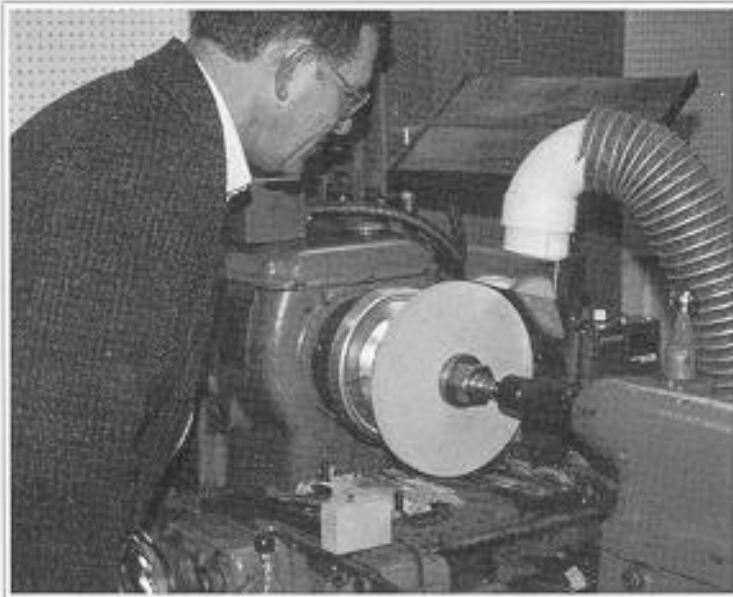
he importance of the growing furniture industry in Mississippi can be measured in both job development and stimulation of the economy. In 1963, this industry consisted of 82 manufacturers with 7,000 employees. In 1992 there were over 300 firms employing 26,000 people with total furniture sales of over \$1.9 billion. In order for the industry to retain its growth, it must establish a firm technical base, which requires sophisticated research and development. State legislators recognized that no individual company was large enough to fund the necessary research, so they appropriated additional monies to the Forest Products Laboratory to setup the program. After careful study by the Lab, a research and technical assistance program was developed. It is known as the Furniture Research Unit.

Production Research

The machinery required for wood and wood product manufacturing is a significant cost for the industry. Wood machining research conducted by Harold (Sandy) Stewart addresses this issue with considerable progress toward understanding machine wear, defects, and waste.

The research has shown high-temperature corrosion and oxidation to be major factors in the wear

Sandy Stewart's tooling research extends tool life and profits for manufacturers.



plied to machining of non-wood materials such as plastics, foam, padding, fabrics, aerospace composites, laminates, and non-ferrous metals.

It is estimated that, as a result of the reduction of machining defects and material waste, manufacturers are enjoying savings in excess of \$6,000,000 annually. An added bonus is that these operational improvements also result in increased productivity which makes them more competitive and paves the way for further expansion of the industry.

In a related area, Stewart is providing the necessary technical assistance to industry as they move toward thin sawkerf technology. The use of thinner saw blades results in increased yield and reduced sawdust waste. With Stewart's encouragement, one manufacturer has adopted this technology for

technical transference and more direct benefit to the industry in a shorter period of time than any other government or IWF sponsored project I have seen."

Research Not Limited To Wood

Three areas of research are being conducted by Furniture Research Unit Scientists Duane Lyon and Vikram Yadama. They are testing and evaluating upholstered furniture frames and their subsequent components; developing computer models of furniture frames and sub-structures; and testing and evaluating non-wood materials used in the manufacturing and shipping of upholstered furniture.

"Our goal in modifying design and manufacturing procedures is to improve the quality while we reduce the cost of furniture production," Yadama says. "There is a need for standardizing performance testing of furniture frames and their components since this is helpful not only in the design and manufacturing processes, but in the marketing of the products."

The research is helpful in guiding designers and manufacturers to more effectively use a variety of wood and wood-based materials and fasteners for im-

"This research has created more direct benefit to the industry in a shorter period of time than any other government or IWF sponsored project I've seen"

John Zinn, Director, IWF

of tungsten carbide and high speed steel tools. This understanding has led to the development of new carbides with alloyed binders which prolong tool life and reduce costs.

Research on tool wear mechanisms is also helpful in developing adhesives and wood composites which cause less tool wear due to lower densities, more uniform density profiles, and higher internal bond strengths. This research is also being ap-

plied to rough mill crosscut saws and as a result has increased lumber yield by 3.4%. This increase translates into an annual savings of \$340,000 for this firm. Once this thin saw technology is implemented throughout the industry, furniture manufacturers can potentially save \$10-15 million annually.

According to John Zinn, Executive Director of the International Woodworking & Supply Fair USA (IWF), "This tool wear research has created more

proving strength and minimizing costs. Improved testing methods, such as automated recliner testing equipment with more accurate load testing, also assist the manufacturer in performing reliable tests more quickly.

Secondly, research into computer modeling of furniture frames and their components helps re-

Research is also concentrated on evaluating materials for use in packaging of the furniture to help economize the actual shipment of the furniture while providing adequate protection.

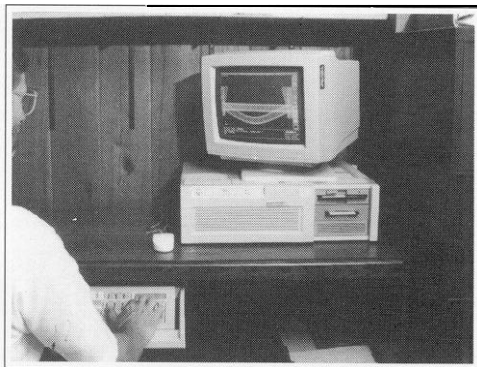
According to Lyon, "We've been very successful in transferring research results to industry. For instance, our research results have saved a local

... research results have saved a local manufacturer about \$5,000,000 over the past five years . . . "

Duane Lyon, Furniture Research Unit

duce the time it takes to begin manufacturing newly designed furniture. Within minutes, the design can be analyzed for performance under service loads using computer structural analysis methods. This technique enables designers to detect critical stress areas and make necessary design changes prior to prototype construction.

Research on non-wood materials in the manufacturing of upholstered materials focuses on man-made polyester fibers and polyurethane foam.



Above: Research into computer modeling of frame testing will help save many manufacturers much time and money,

manufacturer about \$5,000,000 over the past five years and officials at Gold Medal stated that our research saved them \$50,000 last year alone. There are numerous other examples throughout the industry."

Resource Studies

The availability of wood-based materials is a key advantage to the growth and prosperity of the furniture industry in Mississippi. Case goods producers use many types of wood-based materials, while upholstered furniture manufacturers in the state use hardwoods and other forest products for dimension stock and frames.

Though Mississippi has vast forest resources, including several million acres of hardwood timberland, the long-term availability of hardwoods for use in manufacturing has become a source of significant concern to the industry. One of the greatest concerns is the new demand placed on the resource by the pulp and paper industry.

Furniture Research Unit Scientist Steven Bullard is studying the impact of the increased demand for hardwood. His research is assisting the State's furniture manufacturers in several ways. First, a significant effort is underway to specifically describe the potential impact of new utilization patterns on hardwood resources. Trends in growing and harvesting hardwoods are being evaluated to assess the actual extent of potential availability problems. Based on this research, recommendations can be made to ensure adequate availability.

According to Bullard, "Mississippi furniture producers face many changes in the coming years. The potential impact of free trade with Canada and Mexico, for example, or the potential geographic shifts in the population of North America will add additional stress on the availability of our hardwood resources. We must be able to keep Mississippi's furniture producers competitive. Our

research is resulting in positive information which will allow us to maintain our competitiveness, both domestically and internationally."

Decision Software Analysis

Furniture companies in Mississippi use large amounts of lumber for their products and this accounts for a sizable portion of their costs. Therefore, it is very important that manufacturers maximize the yield from this raw material. However, an efficient means of accomplishing this was needed. Philip Steele recognized this problem several years ago and felt that the best approach to addressing this problem was to develop computer software packages that had the capability of analyzing rough mill efficiency. This led to the development of *RIP-X*, which determines and compares the yields obtainable from crosscut-first and rip-first systems. Another software package, *SCORE*, allows the manufacturer to determine the least-cost grade mix of lumber to fill a particular cutting order.

Both packages simulate rough mill performance by cutting digital lumber images, just as actual lumber would be cut. A database of 14,000 board feet of digitally described lumber was developed by sampling lumber in a cross-section of the State's rough mills. Lumber shape and defect locations were determined by sonic digitizing and the data were stored in a database to accurately simulate rough mill processing.

During development of the software, for instance, Batesville Casket Company funded a project to customize *SCORE* for analyzing the company's specific raw materials needs. Industrial Engineer Mark McDonald was convinced that lumber length was an important factor in influencing their rough mill yield and consequently their profitability.

Steele's study indicated that lumber length was an important factor and that yield could be significantly improved and overall costs reduced if certain lengths were favored. McDonald says, "The value of the software is that it contains descriptions of actual lumber with defects. The software analysis supported our initial belief that length had a significant effect on lumber yield. By taking defects into account, it also helped us fine-tune our grade/length mix strategy. As a result, we've changed our lumber purchasing procedures and have realized a considerable reduction in lumber costs."

Steele and his staff are currently developing other custom software for Batesville Casket which will allow them to analyze their own product mix and lumber selection as prices change over time.

Another challenge for furniture manufacturers is to minimize the cost of producing and inventorying the thousands of parts needed in furniture manufacturing. Keeping track of all these parts in order to avoid overproduction, duplication, and delays is an enormous task when done manually.

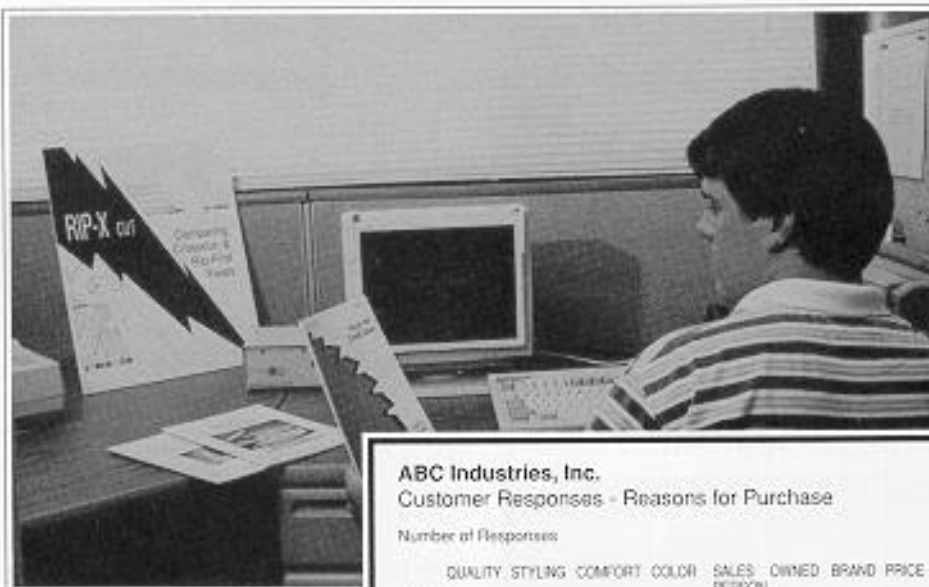
"The value of the software is that it contains descriptions of actual lumber with defects . . . (we) have realized a considerable reduction in lumber costs. "

**Mark McDonald
Industrial Engineer
Batesville Casket Co.**

Dan Seale addressed this problem and developed an efficient software package that can keep track of up to 16,000 parts. Once installed, this software provides instantaneous access to information on parts inventories.

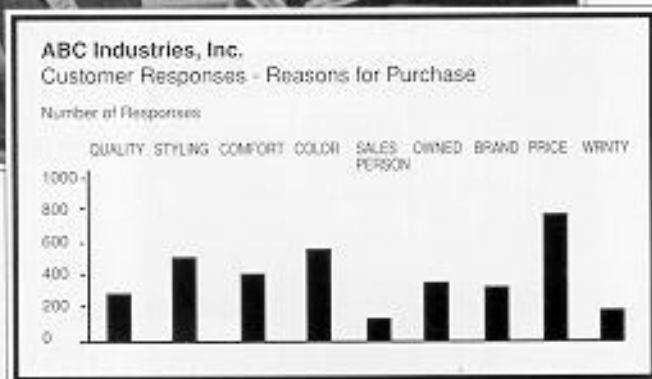
Furthermore, the program also produces routing slips, profit and loss statements, part costing, product costing, suggested pricing, rough mill cutting bills, assembly checklists, bill of materials and machine operating costs and statistics. This program has already been installed in two plants to validate model results and also allow Seale to incorporate improvements suggested by mill managers.

These examples show that this is powerful software that the State's furniture industry can use to dramatically reduce their raw material and production costs.



Above: Important software has already been developed to increase our furniture industry's profitability.

Inset: Customer profiles are helping Mississippi companies determine where and how to market their products.



Marketing Our State's Products

Since furniture is a differentiated rather than a commodity product, a marketing program has been established under the direction of Dan Seale so that participating manufacturers can develop geographic and customer profiles. Initial work involved processing of hang tags that were placed on furniture by the manufacturer and mailed to the Mississippi Forest Products Laboratory by the consumer for processing. Typical customer

profiles by age, income, education level, occupation, and life-style characteristics were developed for each product. This area of research is being expanded to examine placement of retail outlets based on geographic coverage.

Additionally, profiles will be developed that address how far consumers are willing to travel to purchase specific products in rural and urban areas, including such factors as improved roads versus interstate highways. This research could directly benefit as many as 150 Mississippi companies.