THE FEASIBILITY OF PRODUCING WOOD PARTICLEBOARD IN GEORGIA

Prepared for
The Georgia Department of Industry and Trade
100 State Capitol
Atlanta, Georgia

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Acknowledgments

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Summary

The production of wood particleboard in the United States increased from 182,884,000 square feet, on a 3/4-inch thickness basis, in 1957 to 494,388,000 square feet in 1963. The increase in the six-year period was 170%, or an annual rate of growth of 15.3%. The rapid growth can be partly explained by the improvements made in product qualities, the lower selling price in recent years, and the tremendous promotional efforts of the industry.

Although the use of particleboard as core material in the furniture and fixtures industries still accounts for over 50% of the market outlets, the entrance of this product into the building field since 1961 has been an important market development for the industry. The use of particleboard as floor underlayment alone reached 122 million square feet in 1963, or about 25% of the total production in that year. This use is expected to increase further both in volume and in percentage.

There are about 56 active particleboard plants in the nation with a total production capacity of over 737,850,000 square feet a year. Of the 56 plants, four are still under construction. The Pacific and South Atlantic are the major producing regions, while Oregon, California, and North Carolina are the leading states. Virginia, Arkansas, and Michigan also are important states in producing particleboard.

There is a vacuum area, comprising Alabama, Florida, Georgia, South Carolina, Tennessee, Mississippi, and Louisiana, without a major particleboard plant. A Georgia-based particleboard plant could operate profitably in this region, with an absolute freight advantage in Alabama, Florida, and Georgia and a relative freight advantage in some portions of South Carolina, Tennessee, and Mississippi over major existing plants. The freight advantage in these states may range from a few dollars to $35 per thousand square feet, depending upon destination and the location of a competing plant in the South.

The market in the absolute freight advantage area is estimated at 22 million square feet in 1963 and 27 million square feet in 1964. The market in the relative freight advantage area is estimated at 27 million square feet in 1963 and 32 million square feet in 1964. A Georgia-based plant could hope to capture a market of about 16 million to 19 million square feet in the six-state region.
A wood particleboard plant producing 17.6 million square feet a year would require about $1,795,500 for fixed investment and $575,000 for working capital. If it is operated three shifts a day, 250 days a year, and at an f.o.b. mill price of $150 per thousand square feet, the cost and profit statement would show $2,640,000 for gross sales, $1,687,084 for total production costs, $606,187 for depreciation and taxes, and $346,729 for net profit, or 14.63% of the total investment. The payout period would be five years.
INTRODUCTION

This study updates a previous study made in 1958 for the purpose of determining the feasibility of producing wood particleboard in Georgia. In the six-year time span between 1958 and 1964, the wood particleboard industry in the United States has undergone great change and growth, both in markets and in the product itself. The change and growth have created an urgent need for re-examination of the manufacturing opportunity offered in the state.

The objectives of the study are as follows:
1. To present up-to-date information on wood particleboard manufacturing and marketing in the United States.
2. To provide an analysis of freight advantage areas and market potentials for Georgia-based wood particleboard plants.
3. To estimate investment costs for efficient-size plants to be operated in Georgia.
4. To estimate production costs and profits for such plants.

This report is presented in two main parts with several sections in each part. The first part describes the growth and change in production, market outlets, standardization, technology, price and competition, and the distribution of plants in the nation. The second part presents the economics of wood particleboard production in Georgia. An analysis of freight, market, and timber resources for two hypothetical Georgia-based plants is given. Detailed estimates on investments, production costs, and returns for these two plants follow.
THE CURRENT STATE OF THE WOOD PARTICLEBOARD INDUSTRY IN THE UNITED STATES

Production and Capacity

Wood particleboard was first produced in the United States during the World War II period, although commercial production of this board actually started after the war. Production was greatly expanded when new glues were discovered and new machines were developed.

Reliable data concerning the production of wood particleboard are not available for the early postwar period; not even the number of manufacturing plants is accurately known. The most authoritative data concerning this industry were first reported in 1957 by the U. S. Bureau of the Census. In that year total production was reported at 182,884,000 square feet, on a 3/4-inch thickness basis, from 46 plants. It increased to 319,282,000 square feet from 49 plants in 1961 and to 494,388,000 square feet from 50 plants in 1963. The production increase amounted to 170% in the six-year period between 1957 and 1963, or an annual compounded rate of growth of 15.3%. The particleboard industry passed through the recessions of 1957-1958 and 1960-1961 without regression or hesitation. This is indeed a young, growing industry.

Judging from the growth record of the wood particleboard industry in the last few years and the current optimistic forecasts about the national economy and construction activities, particleboard production may reach 593 million square feet in 1964, or a 20% gain over 1963. Detailed figures on production, types of board, and number of plants are given in Table 1.

The number of wood particleboard plants appears to be relatively stable from year to year with the exception of the relatively large increase in 1964. These are net figures, however, and do not show the few plants which closed down, changed hands, or were newly erected each year. This young industry, like most manufacturing operations, offers both opportunities and hazards. In Table 1, the 56 plants listed for 1964 include four new plants which are still under construction, but exclude several plants which are not in operation. 1/

1/ A list of the 56 active wood particleboard plants in the United States is given in Appendix 7, providing information on name, address, personnel, annual capacity, process, and product specifications.
### Table 1

**U. S. PRODUCTION OF WOOD PARTICLEBOARD BY TYPES AND NUMBER OF PLANTS, 1957 TO 1964**

<table>
<thead>
<tr>
<th>Year</th>
<th>Production (in 1,000 sq. ft. on 3/4-in. thickness basis)</th>
<th>Number of Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Multi-Platen Board</td>
<td>Extruded Board</td>
</tr>
<tr>
<td>1957</td>
<td>182,884</td>
<td>144,451</td>
</tr>
<tr>
<td>1959</td>
<td>295,831</td>
<td>255,356</td>
</tr>
<tr>
<td>1960</td>
<td>268,362</td>
<td>231,998</td>
</tr>
<tr>
<td>1961</td>
<td>319,282</td>
<td>284,351</td>
</tr>
<tr>
<td>1962</td>
<td>407,574</td>
<td>366,028</td>
</tr>
<tr>
<td>1963</td>
<td>494,388</td>
<td>453,710</td>
</tr>
<tr>
<td>1964</td>
<td>593,000*</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

*Estimated


The total annual production capacity of 51 active plants (excluding five unknown) will reach 737,850,000 square feet on a 3/4-inch thickness basis in the United States in 1964. Total manufacturing capacity has increased in recent years, and new plants tend to be more automated in design and larger in scale than older plants. Five active plants with unknown capacity are believed to be small operations with no significant influence on the given total production capacity.

The ratio between production and capacity often is referred to as the indicator of production efficiency. The 494,388,000 square feet produced in 1963 was about 75% of the known production capacity in that year (the total capacity excludes the four new plants under construction and the five plants with unknown capacity). If the 1964 production reaches 593 million square feet as anticipated, it will be about 80% of the current total capacity (including the four new plants but excluding the five unknown).

It is to be noted that the ratio between production and capacity sometimes can be misleading. Besides the new plants under construction, which
contribute no actual production, the plants built in 1962 and 1963 still may not reach their top efficiency because of technical problems, but their capacities are counted in the total. In addition, about 13 captive plants, which are operated mostly on a one-shift basis, account for over 60 million square feet (3/4-inch basis) in annual capacity, while their actual production is less than half of their capacities each year.

There are two basic types of particleboard produced -- multi-platen board and extruded board. Extruded board, generally produced for captive use, has remained almost stable in annual production, while multi-platen board has more than tripled since 1957. Multi-platen board accounted for 92% of wood particleboard produced in 1963.

Applications and Market Outlets

In the early years of production, wood particleboard was designed mainly for the utilization of wood wastes from lumber mills or furniture plants and was used largely as a low-cost substitute for more expensive core materials, such as lumber and plywood. Engineering improvements in the last decade have made wood particleboard a unique commodity in the market in its own right. This board has become a prime product in many fields, for it can be engineered and developed to meet end-use requirements not met by other wood products.

End uses of wood particleboard currently fall into the two main categories of core stock and building board. As core stock in the manufacture of furniture and cabinets, wood particleboard has the desirable properties of dimensional stability, smoothness, ease of application, strength, and machinability. It is used largely as cores for flat surfaces which are overlaid with wood veneer or plastic laminates. Wood particleboard is used in volume in the production of wood case goods furniture (chests of drawers, bedroom bureaus, etc.), cabinets, desks, occasional furniture, kitchen counters, and store fixtures and displays.

As building board in the construction business, wood particleboard is used as underlayment for resilient floor coverings, partitions, floor tile, wall sheathing, and sliding doors. A phenolic-bond board was approved by the FHA as an exterior board a few years ago.

Although the use of wood particleboard as core stock still accounts for over one half of the total production, the use as building board has been
expanding rapidly, especially as floor underlayment, in the last few years. The latter usage rose from 106 million square feet, or 26% of the total output, in 1962 to 122 million square feet, or 25%, in 1963. It is expected to reach 166 million square feet, or 28% of total output, in 1964. A breakthrough in this market has been made since 1961 as a result of the tremendous amount of development work done previously. The tremendous potentials in the building field may be the major gateway to further rapid growth of particleboard manufacturing.

Table 2 shows the distribution of wood particleboard among the various market outlets in the United States, based on a recent private survey.

<table>
<thead>
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<th>Outlet</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furniture</td>
<td>16</td>
</tr>
<tr>
<td>Laminators</td>
<td>20</td>
</tr>
<tr>
<td>Store fixtures</td>
<td>3</td>
</tr>
<tr>
<td>Cabinet shops</td>
<td>16</td>
</tr>
<tr>
<td>Builders</td>
<td>13</td>
</tr>
<tr>
<td>Prefab and underlayment</td>
<td>16</td>
</tr>
<tr>
<td>Panel construction</td>
<td>7</td>
</tr>
<tr>
<td>Prefab flooring</td>
<td>5</td>
</tr>
<tr>
<td>Exterior and rural</td>
<td>3</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Product Specifications and Standardization

In the drive to satisfy the different requirements of various end uses, wood particleboard producers turn out a whole range of products with diverse properties. As a general rule, core stock requires good surface with minimum "show-through" of the surface when overlaid with other materials. It also requires dimensional stability, strength, screw-holding power, and machinability. The requirements of building board give emphasis to internal bond strength, water resistance, and even thickness.
Most commercial wood particleboards are produced in thicknesses ranging from \( \frac{1}{4} \) inch to \( 1\frac{1}{2} \) inches, in densities from 35 to 75 pounds per cubic foot, and in panel sizes up to 5 by 20 feet. They can be homogeneous, multi-layered, graduated, fine-surfaced, fiber-surfaced, paper-surfaced, surface-filled, rough-surfaced, sanded, planed, veneer-laminated, plastic-laminated, plastic-coated, printed, and painted.

Three major types of wood particleboard -- splinter, shaving, and flake -- have gained acceptance in the market. Splinter board made from wood residues generally provides the best flatness. Shaving board made from planing mill shavings usually gives the smoothest surface. Flakeboard made with engineered flakes from green wood has the greatest strength. Good-quality boards may be made from any of these three types, but flakeboard has gained over the other two types in the recent years because of its uniform characteristics. In many instances, a mixture of different particles is being used.

In most commercial particleboard plants today, a wood clinic is available for testing the properties of board produced. In some large companies, an independent research department is responsible for the improvement of production or for the developing of new products.

Only five to six years ago, there were complaints about wood particleboard by its users. Misunderstandings were created because the various available products did not have prescribed standards for application and a few poor products appeared on the market. A move was made by a number of wood particleboard producers themselves to set up minimum standards of product properties. This task was taken over by the National Particleboard Association when it was founded in 1960.\(^1\) The Association has worked closely with the Department of Commerce and FHA in developing industry-wide standards for particleboard.

The Commercial Standard, CS236-61, Mat-Formed Wood Particleboard (Interior Use) was issued on June 1, 1961, as well as the FHA-approved Mat-Formed Wood Particleboard for Floor Underlayment on November 14, 1960. The members of the National Particleboard Association are offering written guarantees for their products, and some of them are stamping their boards with the NPA emblem, signifying compliance with recognized tests and standards. Work is being carried

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\(^1\) The National Particleboard Association currently consists of 18 members and has its headquarters in Washington, D. C.
out to develop additional standards for such uses as core stocks and exterior sheathing.\textsuperscript{1/} The West Coast Particleboard Association has also adopted standard specifications for wood particleboard used as floor underlayment and exterior-type panel.\textsuperscript{2/}

**Technology and Processes**

Wood particleboard is an engineered panel made by combining wood flakes, shavings, or splinters with resins and wax and hot pressing them into panels. The properties of a board depend largely upon wood species, type of particles, adhesives, and curing or pressing.

A wide range of wood species, both softwood and hardwood, can be used for making particleboard.\textsuperscript{3/} Generally the low-density species are more desirable than high-density species in making medium-density board. Where a greater screw-holding power and smoother surface are required, a mixture of softwood and hardwood is applied. However, the availability of timber in a given area generally dictates the choice of wood used. Good boards have been made from single species of southern pine, spruce, Douglas fir, and others. Good quality board also is made with such hardwood species as poplar, gum, oak, maple, cypress, or willow in a mixture with softwood species.

Wood in nearly any form can be used to prepare a suitable geometric shape for board manufacture. However, the smaller the particle the less suitable it becomes. As mentioned previously, flake, shaving, and splinter are the major types of wood particle used. Sander dust and sawdust generally are used only as surfacing material.

Adhesives used to bond the particles together are usually thermosetting, synthetic resins, such as urea-formaldehyde, phenol-formaldehyde, and melamine-formaldehyde. Urea resin is usually used because of its low cost. Phenol and

\textsuperscript{1/} Summaries of the commercial standards for mat-formed wood particleboard for floor underlayment and for interior use are given in Appendices 1 and 2.


Melamine resins cost two to three times more than urea but are necessary for durability in the building and construction market.

Wax, in the form of an aqueous emulsion or a melted petrolatum, is usually added to impart stability to the board. Insecticides, fungicides, and fire retardants can be added if necessary.

There are two basic pressing methods, multi-platen and extrusion. In using the multi-platen press, layers of bonded particles are pressed on a mat to produce a predetermined size of board. In forming extruded board, a single layer of bonded particles is forced through a long, heated die. The continuous length of board which emerges from the die is clipped into panels of the desired length. Extruded board is stronger crosswise than lengthwise, while platen board is almost equally strong in both dimensions.

The newest development in the drying and curing of particleboard is dielectric heating, which permits a substantial reduction in time required to press the board into panels. Consequently, it means the reduction of manufacturing costs. It is also reported that the new process provides the much stronger internal bond strength which is required for building board.

More than a dozen commercial processes are currently available in the United States. Fourteen better-known processes for wood particleboard, together with their characteristics, are given in Table 3. Some of the processes have been developed in foreign countries but their franchises are distributed in the United States by local firms, while other processes have been developed in this country. There are two extrusion processes (a third one is out of business) which are generally considered better adapted to a captive or small operation utilizing available wood residues from a sawmill or furniture plant. Multi-platen processes constitute over 90% of the current production, with a wide range of choices. The choice of a process depends upon many considerations, such as product quality, end uses, market, wood supply, investment cost, and the reputation of a process. Many independent engineering firms can provide valuable advice.

It is reported that almost all new plants have experienced some mechanical problems in their "shakedown" period. A well coordinated machine selection

1/ A list of engineering firms and manufacturers or suppliers of equipment for wood particleboard is given in Appendix 6.
### Table 3
**SUMMARY OF COMMERCIAL PROCESSES FOR WOOD PARTICLEBOARD IN THE UNITED STATES**

<table>
<thead>
<tr>
<th>Process Name</th>
<th>Company</th>
<th>Press Type</th>
<th>Type of Particle</th>
<th>Panel Size</th>
<th>Thickness</th>
<th>Press Cycle</th>
<th>Board Produced or Specialties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kreibaum</td>
<td>Dean Co.</td>
<td>Vertical extrusion</td>
<td>Splinter</td>
<td>49&quot; wide</td>
<td>1/2&quot; to 1-7/8&quot;</td>
<td>-</td>
<td>Extruded board</td>
</tr>
<tr>
<td>Lanewood</td>
<td>Lane Co.</td>
<td>Horizontal extrusion</td>
<td>Splinter</td>
<td>48&quot; wide</td>
<td>1/2&quot; to 2&quot;</td>
<td>-</td>
<td>Extruded board</td>
</tr>
<tr>
<td>Bahre (Bison)</td>
<td>Soderhamm Machine Co.</td>
<td>Multi-platen</td>
<td>Flake or splinter</td>
<td>4' x 16'</td>
<td>3/8&quot; to 1-1/2&quot;</td>
<td>4 to 6 mins.</td>
<td>Graduated board</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5' x 16'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behr</td>
<td>Roddis Timblend</td>
<td>Multi-platen</td>
<td>Flake and shaving</td>
<td>4.3' x 16'</td>
<td>3/8&quot; to 1-3/16&quot;</td>
<td>-</td>
<td>3-layer board</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5' x 16'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardwell</td>
<td>Cardwell Machine Co.</td>
<td>Multi-platen</td>
<td>Splinter</td>
<td>4' x 20'</td>
<td>-</td>
<td>10 mins.</td>
<td>Small operation</td>
</tr>
<tr>
<td>Chapman</td>
<td>Chapwood, Inc.</td>
<td>Multi-platen</td>
<td>Shaving and flake</td>
<td>4' x 8'</td>
<td>1/4&quot; to 3/4&quot;</td>
<td>-</td>
<td>Paper-faced with a flake</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Columbia Engineering</td>
<td>Columbia Engineering Co.</td>
<td>Multi-platen</td>
<td>Shaving</td>
<td>5' x 16'</td>
<td>1/4&quot; to 1-3/16&quot;</td>
<td>-</td>
<td>Multi-platen board</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emerite Chemical</td>
<td>Kroehler Mfg. Co.</td>
<td>Multi-platen</td>
<td>Shaving</td>
<td>4' x 8'</td>
<td>1/2&quot; to 1&quot;</td>
<td>4 to 15 mins.</td>
<td>3-layer board</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4' x 12'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fahrni (Novo-Ply)</td>
<td>U. S. Plywood Co.</td>
<td>Multi-platen</td>
<td>Splinter and flake</td>
<td>4' x 16'</td>
<td>3/8&quot; to 1-3/4&quot;</td>
<td>-</td>
<td>3 layers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5' x 16'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6' x 12'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Development</td>
<td>Industrial Development Corp.</td>
<td>Multi-platen</td>
<td>Splinter and flake</td>
<td>5' x 10'</td>
<td>1/4&quot; to 1-1/4&quot;</td>
<td>-</td>
<td>3 layers</td>
</tr>
<tr>
<td>Johnson Process</td>
<td>Johnson &amp; Johnson</td>
<td>Multi-platen</td>
<td>Splinter and flake</td>
<td>-</td>
<td>-</td>
<td>4 to 15 mins.</td>
<td>Small operation</td>
</tr>
<tr>
<td>Macdonald Associates</td>
<td>Macdonald Associates, Inc.</td>
<td>Multi-platen</td>
<td>All types</td>
<td>5' x 10'</td>
<td>1/4&quot; to 1&quot;</td>
<td>7 to 8 mins.</td>
<td>Homogeneous and sandwich forms</td>
</tr>
<tr>
<td>Miller-Hofft</td>
<td>Miller-Hofft, Inc.</td>
<td>Multi-platen</td>
<td>All types</td>
<td>Varied</td>
<td>3/8&quot; to 1-3/16&quot;</td>
<td>-</td>
<td>1 or 3 layers</td>
</tr>
<tr>
<td>Wilco Machine Works</td>
<td>Wilco Machine Works, Inc.</td>
<td>Multi-platen</td>
<td>Flake</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
and a good plant layout are essential in assuring a sound operation at the outset of a new plant.

Price and Competition

The price level of wood particleboard in the United States has been declining since 1957. According to a sales executive of a major manufacturer, several widely known brands of flakeboard were selling at $220 per thousand square feet on a 3/4-inch thickness basis in 1957, with little sales resistance. The price was down to $200 in 1958 and to $180 in 1963. In the six-year period between 1957 and 1963, the drop was 18%. The price levels on warehouse, direct mill shipment, and f.o.b. mill from 1957 to 1963 are given in Table 4.

Table 4
APPROXIMATE PRICE MOVEMENT OF FLAKEBOARD IN THE UNITED STATES, 1957, 1958 AND 1963
(Per 1,000 square feet, based on medium-density board, 3/4-inch thickness)

<table>
<thead>
<tr>
<th>Year</th>
<th>Warehouse</th>
<th>Direct Mill Shipment</th>
<th>F.O.B. Mill</th>
</tr>
</thead>
<tbody>
<tr>
<td>1957</td>
<td>$220</td>
<td>$190</td>
<td>$180</td>
</tr>
<tr>
<td>1958</td>
<td>200</td>
<td>170</td>
<td>155</td>
</tr>
<tr>
<td>1963</td>
<td>180</td>
<td>150</td>
<td>135</td>
</tr>
</tbody>
</table>

Source: W. R. Purifoy, "Charting Particleboard's Road to Prosperity," Wood and Wood Products, September 1963

The warehouse prices refer to a maximum price charged to end users. The prices for direct mill shipment are for direct deliveries to industrial users or to wholesalers with warehouse facilities. The f.o.b. mill prices are the basic prices for mill production. A sharp price drop was recorded between 1957 and 1958. This might be attributed to the economic recession in 1958. However, the decline also is noticeable from a long-range point of view over the past six years.

The industry generally blames the price decline directly on over-expansion of production capacity. Other factors are also involved. Significant causes are the keen competition in marketing and the low production costs of new
plants. The trend in new plants tends to be toward more automation and larger scale. In the last six to seven years, about a dozen new plants have been built with annual production capacity ranging from 15 million to 60 million square feet each on a 3/4-inch thickness basis. In contrast, plants were built with annual capacity ranging from 5 million to 15 million square feet in the early postwar period.

In addition to production scale, new plants can utilize the latest machine models and the newest production techniques. The result in general is a better product with a lower production cost. A number of older plants, consequently, have been forced out of business. The price level of wood particleboard has gone downward, thus making particleboard a more competitive product in the market. As a result, the market for particleboard has expanded greatly in the last few years.

The competition for markets affects not only price and product, but also customer service. Major producers have taken great pains to provide better service in delivery, sales engineering, and advertising.

According to a number of people in the industry, the wood particleboard market will expand further in the next decade because of two existing conditions. First, due to a shortage of high-grade core materials and high-grade veneer for furniture manufacture, wood particleboard will be used in a greater proportion for making furniture. Second, the improved properties of wood particleboard in terms of internal bonding strength and water resistance will make it a more widely accepted material for building purposes. Wood particleboard already has invaded this important field and the market potentials in the building field are tremendous.

Total imports of particleboard are insignificant at the present time, amounting to approximately 1% of domestic production in 1963, but they have been increasing in recent years. Because of the expanded production capacities and low raw material and labor costs in most foreign countries, domestic producers should watch import trends in the future.

The Distribution of Wood Particleboard Plants

In the immediate postwar period, wood particleboard production was concentrated on the West Coast, where a huge volume of wood residues was available from sawmills and plywood plants. The development of flakeboard by using green
round wood has generated a spread of production on a large scale to the East. Today more new plants are built in the East than in the West. This change is significant in the sense of market requirements and transportation costs.

There are about 56 active wood particleboard plants in the United States, of which 16 are in the Pacific Division, 17 in the South Atlantic, six each in the East North Central and West South Central, five in the East South Central, four in the Middle Atlantic, and one each in the West North Central and the Mountain divisions.1/ Oregon and North Carolina are the leading states in particleboard production, with 11 plants each, followed by California, Virginia, and Arkansas, with four plants each; Pennsylvania and Michigan, with three each; Texas, Tennessee, and Mississippi, with two each; and New York, Indiana, Illinois, Minnesota, West Virginia, South Carolina, Kentucky, Idaho, and Washington, with one each.

The distribution of annual production capacity is largely consistent with the plant distribution. The West Region, comprising the Pacific and Mountain divisions, accounts for 45.3% of the nation's capacity, while the remaining regions account for 54.7%. The Pacific Division, with 42.3%, leads all divisions, followed by the South Atlantic -- 24.7%, East North Central -- 9.5%, West South Central -- 8.1%, Middle Atlantic -- 6.5%, East South Central -- 4.3%, Mountain -- 3%, and West North Central -- 1.6%.

Oregon, California, North Carolina, and Virginia are the leading states in production capacity. These four states, with a combined capacity of 487,650,000 square feet (on a 3/4-inch thickness basis), account for 66% of the national capacity. Table 5 gives the detailed figures on number of plants, annual capacity, and percentage of the national capacity by division and by state.

The geographical distribution of particleboard plants in the United States is illustrated on Map 1. Individual plants are grouped into three categories according to size -- 1 to 9.9 million square feet, 10 to 24.9 million square

1/ Geographic groupings are based on the four regions (Northeast, South, North Central, and West) and the nine divisions (New England, Middle Atlantic, West South Central, East South Central, South Atlantic, West North Central, East North Central, Mountain, and Pacific) established by the Bureau of the Census and used in reporting production and plant data in the Census of Manufactures.
Table 5

THE DISTRIBUTION OF THE WOOD PARTICLEBOARD INDUSTRY IN THE U. S.
BY PLANT LOCATION, NUMBER OF PLANTS, AND ANNUAL PRODUCTION CAPACITY, 1964
(in 1,000 sq. ft. on 3/4-inch basis)

<table>
<thead>
<tr>
<th>Division and State</th>
<th>Number of Plants</th>
<th>Annual Capacity</th>
<th>Per Cent of Total U. S. Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>56</td>
<td>737,850(^1)</td>
<td>100.0</td>
</tr>
<tr>
<td>Pacific</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washington</td>
<td>1</td>
<td>7,000</td>
<td>0.9</td>
</tr>
<tr>
<td>Oregon</td>
<td>11*</td>
<td>168,300</td>
<td>22.8</td>
</tr>
<tr>
<td>California</td>
<td>4</td>
<td>137,000</td>
<td>18.6</td>
</tr>
<tr>
<td>South Atlantic</td>
<td>17</td>
<td>182,350</td>
<td>24.7</td>
</tr>
<tr>
<td>Virginia</td>
<td>4</td>
<td>82,000</td>
<td>11.1</td>
</tr>
<tr>
<td>West Virginia</td>
<td>1*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>North Carolina</td>
<td>11</td>
<td>100,350</td>
<td>13.6</td>
</tr>
<tr>
<td>South Carolina</td>
<td>1*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>East North Central</td>
<td>6</td>
<td>70,000</td>
<td>9.5</td>
</tr>
<tr>
<td>Indiana</td>
<td>1</td>
<td>7,000</td>
<td>1.0</td>
</tr>
<tr>
<td>Illinois</td>
<td>1</td>
<td>5,000</td>
<td>0.7</td>
</tr>
<tr>
<td>Michigan</td>
<td>3*</td>
<td>43,000</td>
<td>5.8</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1</td>
<td>15,000</td>
<td>2.0</td>
</tr>
<tr>
<td>West South Central</td>
<td>6</td>
<td>59,600</td>
<td>8.1</td>
</tr>
<tr>
<td>Arkansas</td>
<td>4*</td>
<td>45,000</td>
<td>6.1</td>
</tr>
<tr>
<td>Texas</td>
<td>2</td>
<td>14,600</td>
<td>2.0</td>
</tr>
<tr>
<td>Middle Atlantic</td>
<td>4</td>
<td>48,000</td>
<td>6.5</td>
</tr>
<tr>
<td>New York</td>
<td>1</td>
<td>23,000</td>
<td>3.1</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>3</td>
<td>25,000</td>
<td>3.4</td>
</tr>
<tr>
<td>East South Central</td>
<td>5</td>
<td>31,600</td>
<td>4.3</td>
</tr>
<tr>
<td>Kentucky</td>
<td>1</td>
<td>10,500</td>
<td>1.4</td>
</tr>
<tr>
<td>Tennessee</td>
<td>2</td>
<td>11,800</td>
<td>1.6</td>
</tr>
<tr>
<td>Mississippi</td>
<td>2</td>
<td>9,300</td>
<td>1.3</td>
</tr>
<tr>
<td>Mountain</td>
<td>1</td>
<td>22,000</td>
<td>3.0</td>
</tr>
<tr>
<td>Idaho</td>
<td>1</td>
<td>22,000</td>
<td>3.0</td>
</tr>
<tr>
<td>West North Central</td>
<td>1</td>
<td>12,000</td>
<td>1.6</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1</td>
<td>12,000</td>
<td>1.6</td>
</tr>
</tbody>
</table>

*Annual capacity of one plant in the group is not known.

\(^1\) The total annual production capacity of 51 plants, excluding five plants whose annual capacities are not known.
MAP 1

THE GEOGRAPHICAL DISTRIBUTION OF WOOD PARTICLEBOARD PLANTS IN THE UNITED STATES, 1964

ANNUAL CAPACITY ON 3/4-INCH BASIS
(In Millions of Square Feet)

- 25 AND OVER
- 10 TO 24.9
- 1 TO 9.9

x - UNKNOWN CAPACITY

COMMERCIAL PLANT
CAPTIVE PLANT
NEW PLANT UNDER CONSTRUCTION

Industrial Development Division
Engineering Experiment Station
Georgia Institute of Technology
feet, and 25 million square feet and up. Plants are also classified as commercial, captive, or new plants under construction. Each plant is plotted on the map according to its approximate location, size, and status.

The distribution of wood particleboard plants appears to be either raw material oriented or market oriented, or both. The West Coast, with an excessive production capacity relative to the demand, has to ship its products across the continent in order to reach the eastern markets. Transportation costs run as high as $40 to $50 per thousand square feet (on a 3/4-inch thickness basis). In the East, the major wood particleboard markets are in the states where furniture manufacturers are concentrated -- Virginia, North Carolina, New York, Pennsylvania, and the Great Lakes states. Virginia and North Carolina, with large local furniture manufacturing industries and easy access to markets in the North and the Great Lakes area, have become major particleboard producing centers already. New plants are being built in New York and the Great Lakes states, where the market is sufficient, although timber resources are inadequate for large-scale production. New plants also are being built in Arkansas and eastern Texas, where timber resources are adequate.

Two vacuum areas in the East have no major commercial wood particleboard plants at the present -- the New England Division and the southeastern corner of the South Region. Although New England has limited timber resources and market potentials, it has easy access to the New York-Pennsylvania market. This asset may be somewhat diminished by the existing particleboard production in New York, Pennsylvania, Virginia, and North Carolina.

In contrast, the southeastern corner, which comprises Alabama, Florida, Georgia, South Carolina, Tennessee, Mississippi, and Louisiana, has abundant timber resources and an adequate market for wood particleboard. Although there are two plants in Mississippi and one in South Carolina, they are all captive plants with small production capacity. Tennessee has a captive plant and a medium-sized commercial plant. This large vacuum area of six to seven states without a major commercial particleboard plant offers a number of attractions for such a venture. The advantages of producing wood particleboard in Georgia to serve this area are discussed in terms of timber resources, freight rates, and market potentials in the next section.
It is to be noted that a bagasse board plant has been operated in Vacherie, Louisiana, by the National Bagasse Products Corporation since 1963.\textsuperscript{1} It produces a board with thickness and density ranges comparable with those of wood particleboard. The board is lighter than particleboard and is used in volume as cores of flush doors. It also can be used as plastic or veneer underlayment, but these uses have not been widely accepted at the present. Generally, bagasse board can be used as a substitute for wood particleboard, although it has not yet become a seriously competing item.

It is also reported that Dyna-Tex, Inc., Nashville, Tennessee, has plans to put up a new wood particleboard plant in La Follette, Tennessee. The plans call for an annual capacity of 44 million square feet operating on a three-shift basis to serve the building and furniture industries in the region. A modified Bison System with a dielectric process for curing would be used. The board would be of medium density. If this plant materializes, it will have an effect on the supply of wood particleboard in the Southeast. It also indicates the potentials of wood particleboard manufacture in this area.

\textsuperscript{1} This plant is not listed as a wood particleboard plant in Appendix 7.
Timber and Wood Residue Resources

Wood raw material supply is an important consideration for any wood-based manufacturer. Particleboard manufacture utilizes either wood residues or round wood. Almost all captive particleboard plants in the East use wood residues, although most large commercial plants depend largely on round wood. In the West, however, wood residues are used extensively in many large commercial particleboard plants. The result is a reduction in production cost, thus permitting them to ship their products to the eastern markets.

Shavings are ideal materials for the surface layers of three-layer particleboard, which is one of the best boards on the market. Wood shavings for particleboard should be in dry and clean condition. Other types of wood residues, such as slabs, edgings, and short ends, can be used for splinter-type board, which has gained importance as floor underlayment in recent years. If the volume of wood residues at a given place could meet the wood raw material requirements of a particleboard plant, it would reduce the direct production costs as much as 30%. The advantage over the large plants in the East which use round wood is evident.

Georgia and North Carolina both have large volumes of wood residues available. It is reported that a huge volume of wood shavings is available in the southern part of Georgia for which there is presently almost no market.

For plants based on round wood, Georgia has excellent resources. Georgia leads the southern states in pulpwood supply, growing stock, and saw timber volume. Since flakeboard manufacture requires only pulp-size trees, the relative volume of growing stock in the southern states is significant. (See Table 6.) Georgia is foremost in both total volume and the combined volume of softwood and soft hardwood among the 12 southern states. (Soft-textured wood


2/ Growing stock refers to sound trees with five-inch diameters and above; saw timber refers to sound trees with nine-inch diameters and above.
is more desirable for particleboard manufacture.) The only state which approaches Georgia's volume is North Carolina, which is the largest wood particleboard producing center in the East.

Table 6

VOLUME OF GROWING STOCK BY SPECIES GROUP
ON COMMERCIAL FOREST LAND IN THE SOUTHERN STATES
(in thousand cords)

<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Softwood</th>
<th>Hardwood</th>
<th>Hardwood</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEORGIA</td>
<td>1961</td>
<td>136,595</td>
<td>43,117</td>
<td>56,162</td>
<td>235,874</td>
</tr>
<tr>
<td>North Carolina</td>
<td>1956</td>
<td>105,868</td>
<td>56,769</td>
<td>59,595</td>
<td>222,232</td>
</tr>
<tr>
<td>Louisiana</td>
<td>1954</td>
<td>58,474</td>
<td>42,502</td>
<td>114,589</td>
<td>215,565</td>
</tr>
<tr>
<td>Alabama</td>
<td>1963</td>
<td>107,600</td>
<td>30,000</td>
<td>59,700</td>
<td>197,300</td>
</tr>
<tr>
<td>Virginia</td>
<td>1957</td>
<td>58,205</td>
<td>34,698</td>
<td>81,576</td>
<td>174,479</td>
</tr>
<tr>
<td>Arkansas</td>
<td>1959</td>
<td>72,227</td>
<td>18,474</td>
<td>80,245</td>
<td>170,946</td>
</tr>
<tr>
<td>South Carolina</td>
<td>1958</td>
<td>61,220</td>
<td>31,592</td>
<td>28,305</td>
<td>121,117</td>
</tr>
<tr>
<td>Mississippi</td>
<td>1957</td>
<td>44,117</td>
<td>18,150</td>
<td>45,667</td>
<td>107,994</td>
</tr>
<tr>
<td>Texas</td>
<td>1955</td>
<td>53,030</td>
<td>13,523</td>
<td>35,804</td>
<td>102,357</td>
</tr>
<tr>
<td>Florida</td>
<td>1959</td>
<td>63,713</td>
<td>15,951</td>
<td>21,040</td>
<td>100,704</td>
</tr>
<tr>
<td>Tennessee</td>
<td>1961</td>
<td>17,335</td>
<td>15,851</td>
<td>64,483</td>
<td>97,669</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>1956</td>
<td>6,595</td>
<td>867</td>
<td>11,396</td>
<td>18,858</td>
</tr>
</tbody>
</table>

Sources: Forest survey releases, Southeastern Experiment Station and Southern Experiment Station, Forest Service, U. S. Department of Agriculture

A commercial particleboard plant with an annual capacity of 25 million to 30 million square feet on a 3/4-inch thickness basis would require about 30,000 cords of round wood a year. Actually, any southern state can support such a volume of production without much difficulty. The important factors are the distance of the supply source and the costs involved. Since information on the annual growth-cut relationship on the county level is lacking in most of the southern states, the actual wood supply of a specific locality has to be ascertained by direct investigation.
If only the timber supply within a 50-mile radius of a given place is considered, there are numerous cities and towns in Georgia which can qualify for wood particleboard production. However, only three are selected in this study for illustration purposes -- Newnan, Monticello, and Jesup. Two are relatively close to the Atlanta Metropolitan Area and one is in south Georgia. All three are in redevelopment areas as designated by the Area Redevelopment Administration. A summary of timber resources in a 50-mile radius of each of these three Georgia cities is given in Table 7.

Table 7
AVAILABLE TIMBER RESOURCES IN A 50-MILE RADIUS OF THREE GEORGIA LOCATIONS, 1961

<table>
<thead>
<tr>
<th>Timber Resources</th>
<th>Unit</th>
<th>Newman</th>
<th>Monticello</th>
<th>Jesup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of commercial forest land</td>
<td>1,000 acres</td>
<td>4,126</td>
<td>4,394</td>
<td>4,854</td>
</tr>
<tr>
<td>Yellow pine</td>
<td>1,000 cords</td>
<td>18,601</td>
<td>27,392</td>
<td>30,889</td>
</tr>
<tr>
<td>Other softwood</td>
<td>1,000 cords</td>
<td>19</td>
<td>227</td>
<td>3,356</td>
</tr>
<tr>
<td>Soft hardwood</td>
<td>1,000 cords</td>
<td>7,522</td>
<td>11,552</td>
<td>12,977</td>
</tr>
<tr>
<td>All timber</td>
<td>1,000 cords</td>
<td>26,142</td>
<td>39,171</td>
<td>47,222</td>
</tr>
<tr>
<td>Estimated annual net yield</td>
<td>1,000 cords</td>
<td>1,831</td>
<td>2,721</td>
<td>3,164</td>
</tr>
<tr>
<td>Estimated annual cut</td>
<td>1,000 cords</td>
<td>1,294</td>
<td>1,915</td>
<td>2,697</td>
</tr>
<tr>
<td>Available timber</td>
<td>1,000 cords</td>
<td>537</td>
<td>806</td>
<td>467</td>
</tr>
</tbody>
</table>

Sources: Georgia's Timber, Southeastern Forest Experiment Station, U. S. Forest Service, Asheville, North Carolina, 1963
Alabama Forests, Southern Forest Experiment Station, U. S. Forest Service, New Orleans, Louisiana, 1963

Statistics in Table 7 are listed on area of commercial forest land and on volume of yellow pine, other softwood, soft hardwood, and all timber.\(^1\) The estimated annual net yield and cut are based on the ratio of yield and cut given in the Preliminary Forest Survey Statistics for each forest region in Georgia in 1961. Although Jesup has the largest standing timber volume, its

\(^1\) All timber here refers to the total volume of yellow pine, other softwood, and soft hardwood, but excludes hard hardwood.
available timber is slightly less than in the other two places because heavier cutting for pulpwood is practiced in that region. Monticello has the largest available timber mainly because of the conservation of the national forest area in that region. In any case, a supply of 30,000 cords of soft-textured wood for a particleboard plant of 30 million square feet annual capacity would take only 4% to 6% of the available timber of any of the three Georgia locations.

Freight Advantage Areas

Wood particleboard is shipped either by rail or by truck. In general, railroad transportation is more economical for long-distance shipments, while trucks are more convenient for a short haul. Because of timing flexibility and the saving of reloading costs, truck shipment is more commonly used for distances up to a few hundred miles.

In order to ascertain the areas in which the selected Georgia locations would have a freight advantage over major competing plants in the South, 12 starting points and 33 termination points have been identified. The 12 starting points include three in Georgia, four in North Carolina, two in Virginia, and one each in Tennessee and Arkansas. The 33 termination points are scattered in the Carolinas, Tennessee, Georgia, Alabama, Florida, Mississippi, and Louisiana. Freight rates on both truckload and carload shipments are provided in cents per 100 pounds of wood particleboard from each starting point to each termination point. These detailed rates are given in Appendices 3 and 4.

There are distinct freight advantage areas for the three Georgia locations -- Newnan, Monticello, and Jesup -- over nine out-of-state points where the major competing plants are located. The freight advantage areas for the Georgia plant locations are classified into absolute and relative advantage areas. Absolute advantage refers to at least one or more Georgia plant locations having the lowest rate to a specific termination point. Relative advantage means here that any Georgia starting point is not to be higher in rate than any competing location by 7¢ per 100 pounds for carloads or 16¢ per 100 pounds for truckloads; and it is not to be higher in rate than two competing locations. The truckload freight advantage areas are illustrated on Map 2, and the carload freight advantage areas are presented on Map 3. The absolute and relative freight advantage points are distinguished by the different symbols on the maps.
MAP 2
THE TRUCKLOAD FREIGHT ADVANTAGE AREAS OF PROPOSED GEORGIA-BASED WOOD PARTICLEBOARD PLANTS, 1964

LEGEND
○ SELECTED PLANT LOCATION IN GEORGIA
● LOCATION OF MAJOR COMPETING PLANT
▲ ABSOLUTE RATE ADVANTAGE AREA
Δ RELATIVE RATE ADVANTAGE AREA

Industrial Development Division
Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
The selected plant locations in Georgia have an absolute freight advantage over any existing major wood particleboard manufacturing plant in the states of Georgia, Alabama, and Florida. The relative freight advantage area extends into South Carolina, Tennessee, and Mississippi. Both truck and rail freight advantage areas are similar.

Based on the freight rates given in Appendices 3 and 4, transportation costs per thousand square feet of wood particleboard are given in Table 8 and Table 9. Six starting points and 18 termination points are selected in the tables. Monticello is representative of the other Georgia plant locations. All 18 terminations are in either the absolute or relative freight advantage areas except Knoxville, Tennessee.

It should be noted that all freight data provided here are intended to give only a picture of intraregional competition. As to interregional competition, Georgia's position is about equal to that of North Carolina-Virginia in shipments to the Midwest or the Great Lakes states, but it would not be competitive with the latter group in shipments to the New York-Pennsylvania area. In shipments to the Gulf states and the Southwest, any Georgia plant would face stiff competition from the plants located in Arkansas, Louisiana, and Texas.

A wood particleboard plant in Georgia would have to consider the three-state area of Georgia, Alabama, and Florida as the basic marketing area, plus South Carolina, Tennessee, and Mississippi as the fringe marketing district. However, special product properties, lower price, or vigorous sale efforts could greatly expand the marketing distance far beyond the stated freight advantage areas.

The Southeastern Market

Since the volume of wood particleboard production in the United States is known and the volume of exports and imports is insignificant, the market distribution of particleboard by state can be reasonably estimated by the output indexes of industries which are the prime users of the board in each state. Several indicators which do give output value by state are wood furniture, not upholstered; metal household furniture; household furniture, n.e.c.; and new house starts.

The market distribution of wood particleboard in the six-state area of Alabama, Florida, Georgia, South Carolina, Tennessee, and Mississippi is given
Table 8
TRUCKLOAD RATES PER THOUSAND SQUARE FEET
OF WOOD PARTICLEBOARD,* 1964

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Charleston, S. C.</td>
<td>$23.50</td>
<td>$26.00</td>
<td>$25.06</td>
<td>$25.06</td>
<td>$28.82</td>
<td>$56.71</td>
<td></td>
</tr>
<tr>
<td>Greenville, S. C.</td>
<td>20.05</td>
<td>25.06</td>
<td>16.60</td>
<td>26.63</td>
<td>20.36</td>
<td>51.69</td>
<td></td>
</tr>
<tr>
<td>Chattanooga, Tenn.</td>
<td>20.99</td>
<td>32.58</td>
<td>23.50</td>
<td>35.72</td>
<td>19.11</td>
<td>38.54</td>
<td></td>
</tr>
<tr>
<td>Knoxville, Tenn.</td>
<td>24.44</td>
<td>28.82</td>
<td>18.80</td>
<td>31.96</td>
<td>12.53</td>
<td>47.93</td>
<td></td>
</tr>
<tr>
<td>Nashville, Tenn.</td>
<td>27.57</td>
<td>37.91</td>
<td>29.76</td>
<td>40.73</td>
<td>26.00</td>
<td>34.78</td>
<td></td>
</tr>
<tr>
<td>Atlanta, Ga.</td>
<td>12.53</td>
<td>30.39</td>
<td>23.50</td>
<td>32.58</td>
<td>22.56</td>
<td>44.17</td>
<td></td>
</tr>
<tr>
<td>Augusta, Ga.</td>
<td>15.98</td>
<td>25.06</td>
<td>20.99</td>
<td>26.63</td>
<td>25.06</td>
<td>52.63</td>
<td></td>
</tr>
<tr>
<td>Columbus, Ga.</td>
<td>15.98</td>
<td>34.46</td>
<td>28.20</td>
<td>35.09</td>
<td>27.57</td>
<td>36.97</td>
<td></td>
</tr>
<tr>
<td>Macon, Ga.</td>
<td>10.97</td>
<td>31.96</td>
<td>26.63</td>
<td>31.96</td>
<td>26.63</td>
<td>46.05</td>
<td></td>
</tr>
<tr>
<td>Savannah, Ga.</td>
<td>19.42</td>
<td>28.82</td>
<td>26.00</td>
<td>28.20</td>
<td>28.82</td>
<td>53.26</td>
<td></td>
</tr>
<tr>
<td>Valdosta, Ga.</td>
<td>18.48</td>
<td>34.46</td>
<td>30.39</td>
<td>33.84</td>
<td>31.96</td>
<td>48.87</td>
<td></td>
</tr>
<tr>
<td>Birmingham, Ala.</td>
<td>22.56</td>
<td>35.72</td>
<td>28.82</td>
<td>37.91</td>
<td>25.06</td>
<td>34.15</td>
<td></td>
</tr>
<tr>
<td>Mobile, Ala.</td>
<td>29.76</td>
<td>42.92</td>
<td>36.66</td>
<td>44.17</td>
<td>34.46</td>
<td>30.39</td>
<td></td>
</tr>
<tr>
<td>Tuscaloosa, Ala.</td>
<td>25.06</td>
<td>37.91</td>
<td>31.02</td>
<td>39.16</td>
<td>27.57</td>
<td>31.33</td>
<td></td>
</tr>
<tr>
<td>Miami, Fla.</td>
<td>37.91</td>
<td>45.74</td>
<td>42.92</td>
<td>45.11</td>
<td>45.11</td>
<td>66.11</td>
<td></td>
</tr>
<tr>
<td>Tampa, Fla.</td>
<td>31.02</td>
<td>40.73</td>
<td>37.28</td>
<td>39.16</td>
<td>40.10</td>
<td>57.96</td>
<td></td>
</tr>
<tr>
<td>Meridian, Miss.</td>
<td>28.82</td>
<td>41.36</td>
<td>34.46</td>
<td>42.92</td>
<td>31.02</td>
<td>26.94</td>
<td></td>
</tr>
</tbody>
</table>

*Medium density board weighing 3,133 pounds per 1,000 square feet or 47 pounds per cubic foot.
Table 9
CARLOAD RATES PER THOUSAND SQUARE FEET
OF WOOD PARTICLEBOARD,* 1964

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbia, S. C.</td>
<td>6.74</td>
<td>7.83</td>
<td>5.95</td>
<td>7.68</td>
<td>7.68</td>
<td>27.88</td>
</tr>
<tr>
<td>Chattanooga, Tenn.</td>
<td>6.58</td>
<td>14.41</td>
<td>7.68</td>
<td>15.51</td>
<td>5.80</td>
<td>20.99</td>
</tr>
<tr>
<td>Knoxville, Tenn.</td>
<td>7.83</td>
<td>11.12</td>
<td>5.64</td>
<td>13.78</td>
<td>4.70</td>
<td>24.12</td>
</tr>
<tr>
<td>Nashville, Tenn.</td>
<td>10.18</td>
<td>16.29</td>
<td>11.74</td>
<td>17.39</td>
<td>8.77</td>
<td>18.95</td>
</tr>
<tr>
<td>Atlanta, Ga.</td>
<td>4.70</td>
<td>12.69</td>
<td>7.68</td>
<td>14.10</td>
<td>7.36</td>
<td>22.24</td>
</tr>
<tr>
<td>Augusta, Ga.</td>
<td>5.33</td>
<td>10.03</td>
<td>6.58</td>
<td>9.71</td>
<td>8.30</td>
<td>25.69</td>
</tr>
<tr>
<td>Columbus, Ga.</td>
<td>5.80</td>
<td>15.04</td>
<td>10.81</td>
<td>15.35</td>
<td>8.77</td>
<td>20.21</td>
</tr>
<tr>
<td>Macon, Ga.</td>
<td>4.70</td>
<td>13.78</td>
<td>9.40</td>
<td>13.47</td>
<td>9.71</td>
<td>22.56</td>
</tr>
<tr>
<td>Savannah, Ga.</td>
<td>6.89</td>
<td>11.43</td>
<td>8.77</td>
<td>10.81</td>
<td>11.12</td>
<td>27.26</td>
</tr>
<tr>
<td>Birmingham, Ala.</td>
<td>7.36</td>
<td>15.66</td>
<td>11.43</td>
<td>16.29</td>
<td>8.46</td>
<td>18.33</td>
</tr>
<tr>
<td>Mobile, Ala.</td>
<td>12.06</td>
<td>18.17</td>
<td>15.82</td>
<td>18.64</td>
<td>15.04</td>
<td>16.13</td>
</tr>
<tr>
<td>Tuscaloosa, Ala.</td>
<td>8.30</td>
<td>16.29</td>
<td>13.16</td>
<td>16.92</td>
<td>10.18</td>
<td>16.76</td>
</tr>
<tr>
<td>Miami, Fla.</td>
<td>16.29</td>
<td>19.27</td>
<td>18.01</td>
<td>18.95</td>
<td>19.11</td>
<td>33.21</td>
</tr>
<tr>
<td>Tampa, Fla.</td>
<td>13.00</td>
<td>17.23</td>
<td>16.13</td>
<td>16.92</td>
<td>17.23</td>
<td>29.14</td>
</tr>
<tr>
<td>Meridian, Miss.</td>
<td>11.11</td>
<td>17.54</td>
<td>15.04</td>
<td>-</td>
<td>13.00</td>
<td>13.31</td>
</tr>
</tbody>
</table>

*Medium density board weighing 3,133 pounds per 1,000 square feet or 47 pounds per cubic foot.
in Table 10. The estimates are presented in two groups, according to the freight analysis indicated in the previous section. The first group, which comprises Alabama, Florida, and Georgia, had an estimated market of 22,222,000 square feet on a 3/4-inch basis in 1963 and 26,674,000 square feet in 1964. This group is the basic marketing area for any Georgia-based wood particleboard plant. Both Georgia and Florida have an estimated market of 8 to 10 million square feet a year and Alabama a market of 5 to 6 million square feet a year.

The second group, which comprises South Carolina, Tennessee, and Mississippi, had an estimated market of 26,977,000 square feet in 1963 and 32,151,000 square feet in 1964. Tennessee accounts for more than 50% of the market in this group. A Georgia-based particleboard plant may hope to penetrate a portion of this market.

Table 10
ESTIMATED WOOD PARTICLEBOARD MARKET BY OUTLETS IN THE SIX SOUTHERN STATES, 1963 AND 1964
(in 1,000 sq. ft. on a 3/4-in. thickness basis)

<table>
<thead>
<tr>
<th>State</th>
<th>1963 Total</th>
<th>1963 Furniture and Fixtures</th>
<th>1963 Floor Underlayment</th>
<th>1964 Total</th>
<th>1964 Furniture and Fixtures</th>
<th>1964 Floor Underlayment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>5,370</td>
<td>4,288</td>
<td>1,082</td>
<td>6,388</td>
<td>4,911</td>
<td>1,477</td>
</tr>
<tr>
<td>Florida</td>
<td>8,484</td>
<td>7,718</td>
<td>766</td>
<td>9,885</td>
<td>8,839</td>
<td>1,046</td>
</tr>
<tr>
<td>Georgia</td>
<td>8,368</td>
<td>4,661</td>
<td>3,707</td>
<td>10,401</td>
<td>5,338</td>
<td>5,063</td>
</tr>
<tr>
<td>Total</td>
<td>22,222</td>
<td>16,667</td>
<td>5,555</td>
<td>26,674</td>
<td>19,088</td>
<td>7,586</td>
</tr>
<tr>
<td>South Carolina</td>
<td>6,275</td>
<td>4,586</td>
<td>1,689</td>
<td>7,559</td>
<td>5,252</td>
<td>2,307</td>
</tr>
<tr>
<td>Tennessee</td>
<td>14,446</td>
<td>11,335</td>
<td>3,111</td>
<td>17,231</td>
<td>12,981</td>
<td>4,250</td>
</tr>
<tr>
<td>Mississippi</td>
<td>6,256</td>
<td>5,369</td>
<td>887</td>
<td>7,361</td>
<td>6,149</td>
<td>1,212</td>
</tr>
<tr>
<td>Total</td>
<td>26,977</td>
<td>21,290</td>
<td>5,687</td>
<td>32,151</td>
<td>24,382</td>
<td>7,769</td>
</tr>
</tbody>
</table>

1/ Appendix 5 gives the procedure used in estimating the six-state wood particleboard market.
The table gives estimates on two major particleboard outlets -- furniture and fixtures and floor underlayment. Census data on annual production volume of wood particleboard for floor underlayment provide a convenient index for the estimates. The furniture and fixtures outlet indicated in the table represents all outlets for wood particleboard except floor underlayment. The ratio between furniture and fixtures and floor underlayment is roughly 3 to 2 in each state except Florida and Mississippi, where concrete floors predominate.

**Products and Plant Scale**

Any Georgia-based wood particleboard plant would have to consider production of both furniture-core-type and floor-underlayment-type or building-type boards. Even though the market for furniture-core-type board still is dominant (about 3 to 2 in comparison with floor-underlayment-type), the market for building-type board is gaining more rapidly than the traditional use of particleboard as core material. In planning future particleboard production in the area, this marketing trend should be considered.

If a new Georgia-based particleboard plant is planned to adapt to the regional needs, the scale of production will have to be consistent with the regional market. Two hypothetical levels of penetration in the six-state market are presented in Table 11. One calls for a 50% penetration in the basic marketing area of Alabama, Florida, and Georgia and a 20% penetration in the fringe area of South Carolina, Tennessee, and Mississippi. Another plan calls for various degrees of market penetration in the six states. The results of the two plans are surprisingly close, each amounting to over 16 million square feet for 1963 and over 19 million square feet for 1964.

In considering the existing regional market based on the freight advantage areas and the future growth of the market in these areas, a Georgia-based wood particleboard plant with 15 million to 25 million square feet annual capacity on a 3/4-inch thickness basis may be adequate to take care of regional needs.

As is well known, the larger a production scale is, the lower the unit cost will be. This also holds true for production costs. The larger a production volume is, the lower will be the production costs per unit. In fact, most of the existing commercial particleboard plants (excluding captive operations) in the United States are over 10 million square feet on a 3/4-inch thickness basis in annual capacity.
Table 11
TWO HYPOTHETICAL LEVELS OF PENETRATION OF THE SIX-STATE MARKET
FOR A GEORGIA-BASED WOOD PARTICLEBOARD PLANT, 1963 AND 1964

<table>
<thead>
<tr>
<th>Level of Market Penetration</th>
<th>1963</th>
<th></th>
<th>1964</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Furniture and Fixtures</td>
<td>Floor Underlayment</td>
</tr>
<tr>
<td>1/2 of A&lt;sup&gt;1/&lt;/sup&gt;</td>
<td>11,111</td>
<td>8,333</td>
<td>2,778</td>
</tr>
<tr>
<td>1/5 of B&lt;sup&gt;2/&lt;/sup&gt;</td>
<td>5,395</td>
<td>4,258</td>
<td>1,137</td>
</tr>
<tr>
<td>Total</td>
<td>16,506</td>
<td>12,591</td>
<td>3,915</td>
</tr>
<tr>
<td>2/5 Alabama</td>
<td>2,148</td>
<td>1,715</td>
<td>433</td>
</tr>
<tr>
<td>2/3 Florida</td>
<td>5,655</td>
<td>5,145</td>
<td>510</td>
</tr>
<tr>
<td>1/2 Georgia</td>
<td>4,184</td>
<td>2,330</td>
<td>1,854</td>
</tr>
<tr>
<td>1/10 South Carolina</td>
<td>627</td>
<td>458</td>
<td>169</td>
</tr>
<tr>
<td>1/5 Tennessee</td>
<td>2,889</td>
<td>2,267</td>
<td>622</td>
</tr>
<tr>
<td>1/10 Mississippi</td>
<td>625</td>
<td>537</td>
<td>88</td>
</tr>
<tr>
<td>Total</td>
<td>16,128</td>
<td>12,452</td>
<td>3,676</td>
</tr>
</tbody>
</table>

<sup>1/</sup> A includes the combined markets in Alabama, Florida, and Georgia.

<sup>2/</sup> B includes the combined markets in South Carolina, Tennessee, and Mississippi.

An integrated operation producing wood particleboard in conjunction with southern pine plywood may be an ideal business combination in this region. Since the production of southern pine plywood would generate about two tons of pine core per thousand board feet of logs consumed, an annual production of 50 million square feet of southern pine plywood would create a surplus of 38,562 tons of pine core, which would be large enough to support a wood particleboard plant with an annual capacity of 19 million to 20 million square feet on a 3/4-inch thickness basis. Since southern pine plywood manufacture is a new and growing industry in the South,<sup>1/</sup> a potential producer of pine

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<sup>1/</sup> Tze I. Chiang, The Feasibility of Producing Southern Pine Plywood in Georgia, Industrial Development Division, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Georgia, October 1963.
plywood might well give thought to wood particleboard production as a part of an integrated enterprise.

Possible Investment Costs and Returns

Two sets of costs and returns for wood particleboard production are given in this section. Basic data on investment and production were obtained from two leading engineering companies for wood particleboard plants in the United States. Detailed returns were worked out, based on the given data. It should be noted that all figures provided in this section are intended merely to give a broad indication of likely costs and profits for a plant under certain given conditions. Although there is no assurance that a plant could be built and operated for the specific costs given, the estimates are considered to be reasonable and should be regarded as guides.

The first plant is based on a Miller-Hofft process with annual production of 17 million square feet on a 3/4-inch thickness basis and a three-shift operation for 250 days a year. Fixed investments, including building, machinery, and miscellaneous, come to $1,795,500, and working capital is estimated at $575,000. Based on an f.o.b. mill price of $150 per thousand square feet, gross sales would be $2,640,000, total production costs $1,687,084, depreciation and taxes $606,187, and net return $346,729, or 14.63% of the total investment. A break-even chart provided in Figure 1 indicates that an annual production level of 7.6 million square feet is the break-even point for covering the total costs, and an annual production level of 5.4 million square feet is the break-even point for covering the out-of-pocket costs.

The second plant is based on a Macdonald Associates process with annual production of 24.3 million square feet on a 3/4-inch thickness basis and a three-shift operation for 300 days a year. Fixed investments, including building, machinery, and auxiliaries, come to $1,972,450, and working capital is estimated at $760,800. Based on an f.o.b. mill price of $150 per thousand square feet, gross sales would be $3,645,000, total production costs $2,035,007, depreciation and taxes $967,506, and net return $642,487, or 23.51% of the total investment. An annual production level of 8.1 million square feet is the break-even point for covering total costs, and 6.1 million square feet is the break-even point for covering out-of-pocket costs. (See Figure 2.)
F.o.b. mill prices of $140 and $145 per thousand square feet are also provided in the estimates of costs and returns for the above two plants. The current delivered prices of flakeboard in Atlanta range from $180 to $220 per thousand square feet on a 3/4-inch thickness basis. An f.o.b. mill-price range from $145 to $155 is reported for the major competing plants in Arkansas, North Carolina, and Virginia.

The detailed production conditions, estimated costs and returns, summary statements, and break-even charts for the two model plants mentioned are given separately in the following tables and figures in this section.
PLANT NO. 1

Miller-Hofft Process
5' x 10' x 16 openings
17,600,000 square feet per year, 3/4-inch basis
Based on 22 productive hours per day and 250 working days a year

A. Estimated Fixed Investment

1. Building
   Manufacturing area 12,000 sq. ft.  
   Warehousing area 20,000 sq. ft.  
   Foundation and shedding 32,000 sq. ft. @ $6.00/sq. ft.  
   Site preparation 10,000  
   $ 192,000
   $ 10,000
   $ 7,500
   209,500

2. Miller-Hofft Fully Automatic System
   Engineering, supervision of erection and initial operation 1,050,000

3. Auxiliary equipment, including fork lift trucks; bulk storage for glue, wax, and oil; heating and ventilating equipment; automatic finishing equipment; miscellaneous saws and packaging equipment; and laboratory facilities 368,000

4. Miscellaneous
   Freight, erection, and contingencies 168,000
   Total Fixed Investment $1,795,500

B. Operational Conditions

1. Wood raw material: Southern yellow pine pulpwood logs, assumed to weigh 55 lbs./cu. ft. at 50% moisture content, wet basis, and at approximately 84 cu. ft. of solid wood per cord, or about 4,600 lbs. per cord.

2. Resin and wax: Resin treatment based on the use of urea-formaldehyde mix at 65% solid content. Treatment at the rate of 7% resin solids based on the oven dry weight of wood. Wax emulsion treatment based on the use of wax emulsion mix at 45% solid content. Treatment at the rate of 1% wax solids based on the oven dry weight of wood.

3. Production: Based on 3/4-inch sanded board produced at the rate of 4 cycles per hour, or 3,200 sq. ft. per hour.
4. Labor requirement for the plant is estimated as follows:

<table>
<thead>
<tr>
<th>Area</th>
<th>Classification</th>
<th>No. Men Per Job</th>
<th>Man Hours Per Day</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yard</td>
<td>Unloading Lift Operator</td>
<td>1</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Yard</td>
<td>Log Handlers</td>
<td>2</td>
<td>48</td>
<td>1</td>
</tr>
<tr>
<td>Yard</td>
<td>Debarker Operator</td>
<td>1</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Yard</td>
<td>Saw Operator</td>
<td>1</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Preparation Area</td>
<td>Flaker Operators</td>
<td>3</td>
<td>72</td>
<td>2</td>
</tr>
<tr>
<td>Preparation Area</td>
<td>Dryer Operator</td>
<td>1</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>Press Room</td>
<td>Former Operator</td>
<td>1</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>Press Room</td>
<td>Press Operator</td>
<td>1</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>Press Room</td>
<td>Utility Operator</td>
<td>1</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>Press Room</td>
<td>Fork Lift Operator</td>
<td>1</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Finishing Dept.</td>
<td>Fork Lift Operator</td>
<td>1</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Finishing Dept.</td>
<td>Saws and Sanders</td>
<td>3</td>
<td>72</td>
<td>2</td>
</tr>
<tr>
<td>Warehouse</td>
<td>Warehousing and Carloading</td>
<td>4</td>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>General</td>
<td>Shift Foreman</td>
<td>1</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>General</td>
<td>Maintenance-Sharpener</td>
<td>1</td>
<td>24</td>
<td>2</td>
</tr>
</tbody>
</table>

Total Man Hours/Day - Rate 1 = 200 Hours - Unskilled Labor.
Total Man Hours/Day - Rate 2 = 264 Hours - Semi-skilled Labor.
Total Man Hours/Day - Rate 3 = 24 Hours - Supervision.

Man Hours/M Sq. Ft. - Rate 1 = 2.84 Man Hours/M Sq. Ft.
Man Hours/M Sq. Ft. - Rate 2 = 3.75 Man Hours/M Sq. Ft.
Man Hours/M Sq. Ft. - Rate 3 = .34 Man Hours/M Sq. Ft.

C. Estimated Production Costs
(Per 1,000 (M) sq. ft. on a 3/4-inch thickness basis)

1. Raw Material Costs

Wood costs = 1.38 cords/M sq. ft. @ $15.00/cord
            = 1.38 x 15.00 = $20.70/M sq. ft.

Resin costs = 270# UF @ 65% solids/M sq. ft. @ $0.085/lb.
             = 270 x .085 = $22.95/M sq. ft.

Catalyst costs = 16.2# catalyst/M sq. ft. @ $0.10/lb.
                = 16.2 x .10 = $1.62/M sq. ft.

Wax emulsion = 55.6# wax emulsion @ 45% solids/M sq. ft. @ $0.10/lb.
               = 55.6 x .10 = $5.56/M sq. ft.

Total Raw Material Costs = $50.83/M sq. ft.
2. Utility Costs

Fuel oil, dryer = 37.1 gal./M sq. ft. @ $0.11/gal.
= 37.1 x .11 = $4.08/M sq. ft.

Power = 250 kwh/M sq. ft. @ $0.015/kwh
= 250 x .015 = $3.75/M sq. ft.

Steam = 1,750#/M sq. ft. @ $0.50/1,000 lbs.
= 1.75 x .50 = $0.88/M sq. ft.

Total Utility Costs $8.71/M sq. ft.

3. Direct Labor Costs

Rate 1 = unskilled labor $1.25/hour
Rate 2 = semi-skilled labor $1.74/hour
Rate 3 = supervision $2.50/hour

Rate 1 = 2.84 man hrs./M sq. ft. x $1.25 = $3.55/M sq. ft.
Rate 2 = 3.75 man hrs./M sq. ft. x $1.75 = $6.57/M sq. ft.
Rate 3 = .34 man hrs./M sq. ft. x $2.50 = $0.85/M sq. ft.

Total Direct Labor Cost $10.97/M sq. ft.

4. Other Fixed Costs

Depreciation -- building at 20 years and equipment at 10 years
Maintenance and supplies -- at 3% of fixed investment
Property taxes -- at 1% of fixed investment
Insurance -- at 1% of fixed investment
Selling expense -- at 5% of gross sales
General administration -- at 5% of manufacturing costs
Interest rate -- at 6% of total investment

D. Estimated Working Capital

1. One month's glue supply $ 44,000
2. Three months' wood supply $ 91,000
3. One month's finished goods $220,000
4. One month's invoices payable $220,000

Total $575,000
Table 12

ESTIMATED COSTS AND RETURNS OF WOOD PARTICLEBOARD PLANT NO. 1

(Based on annual production of 17.6 million sq. ft. on a 3/4-in. thickness basis and on a 3-shift operation, 250 days a year)

<table>
<thead>
<tr>
<th>Mill Sale Price (f.o.b. mill/1,000 square feet):</th>
<th>$140.00</th>
<th>$145.00</th>
<th>$150.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Sales</td>
<td>$2,464,000</td>
<td>$2,552,000</td>
<td>$2,640,000</td>
</tr>
<tr>
<td>Variable Costs Per 1,000 sq. ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw Materials</td>
<td>$894,608</td>
<td>$894,608</td>
<td>$894,608</td>
</tr>
<tr>
<td>Utilities</td>
<td>153,296</td>
<td>153,296</td>
<td>153,296</td>
</tr>
<tr>
<td>Direct Labor</td>
<td>193,072</td>
<td>193,072</td>
<td>193,072</td>
</tr>
<tr>
<td>Total</td>
<td>$1,240,976</td>
<td>$1,240,976</td>
<td>$1,240,976</td>
</tr>
<tr>
<td>Variable Profit</td>
<td>$1,223,024</td>
<td>$1,311,024</td>
<td>$1,399,024</td>
</tr>
<tr>
<td>Fixed Costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-of-Pocket Fixed Costs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance and Supplies</td>
<td>$53,865</td>
<td>$53,865</td>
<td>$53,865</td>
</tr>
<tr>
<td>Property Taxes</td>
<td>17,955</td>
<td>17,955</td>
<td>17,955</td>
</tr>
<tr>
<td>Insurance</td>
<td>17,955</td>
<td>17,955</td>
<td>17,955</td>
</tr>
<tr>
<td>Interest</td>
<td>142,230</td>
<td>142,230</td>
<td>142,230</td>
</tr>
<tr>
<td>Selling Expense</td>
<td>123,200</td>
<td>127,600</td>
<td>132,000</td>
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<tr>
<td>General Administration</td>
<td>82,103</td>
<td>82,103</td>
<td>82,103</td>
</tr>
<tr>
<td>Total</td>
<td>$437,308</td>
<td>$441,708</td>
<td>$446,108</td>
</tr>
<tr>
<td>Cash Income</td>
<td>$785,716</td>
<td>$869,316</td>
<td>$952,916</td>
</tr>
<tr>
<td>Non-Fund Fixed Cost:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>$169,075</td>
<td>$169,075</td>
<td>$169,075</td>
</tr>
<tr>
<td>Net Income before Taxes</td>
<td>$616,641</td>
<td>$700,241</td>
<td>$783,841</td>
</tr>
</tbody>
</table>
Table 13  
SUMMARY STATEMENT OF ESTIMATED COSTS AND RETURNS  
OF WOOD PARTICLEBOARD PLANT NO. 1  
(Based on annual production of 17.6 million sq. ft. on a 3/4-in.  
thickness basis and on a 3-shift operation, 250 days a year)  

<table>
<thead>
<tr>
<th>Mill Sale Price (f.o.b. mill/1,000 square feet):</th>
<th>$140.00</th>
<th>$145.00</th>
<th>$150.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Sales</td>
<td>$2,464,000</td>
<td>$2,552,000</td>
<td>$2,640,000</td>
</tr>
<tr>
<td>Variable Costs</td>
<td>1,240,976</td>
<td>1,240,976</td>
<td>1,240,976</td>
</tr>
<tr>
<td>Variable Profit</td>
<td>$1,223,024</td>
<td>$1,311,024</td>
<td>$1,399,024</td>
</tr>
<tr>
<td>Out-of-Pocket Fixed Costs</td>
<td>437,308</td>
<td>441,708</td>
<td>446,108</td>
</tr>
<tr>
<td>Cash Income</td>
<td>$785,716</td>
<td>$869,316</td>
<td>$952,916</td>
</tr>
<tr>
<td>Depreciation</td>
<td>169,075</td>
<td>169,075</td>
<td>169,075</td>
</tr>
<tr>
<td>Net Income before Taxes</td>
<td>$616,641</td>
<td>$700,241</td>
<td>$783,841</td>
</tr>
<tr>
<td>Taxes, Federal (50%)¹</td>
<td>308,320</td>
<td>350,120</td>
<td>397,920</td>
</tr>
<tr>
<td>State (5%)¹</td>
<td>30,832</td>
<td>35,012</td>
<td>39,192</td>
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<tr>
<td>Net Income after Taxes</td>
<td>$277,489</td>
<td>$315,109</td>
<td>$346,729</td>
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<tr>
<td>Investment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Investment</td>
<td>$1,795,500</td>
<td>$1,795,500</td>
<td>$1,795,500</td>
</tr>
<tr>
<td>Working Capital</td>
<td>575,000</td>
<td>575,000</td>
<td>575,000</td>
</tr>
<tr>
<td>Total</td>
<td>$2,370,500</td>
<td>$2,370,500</td>
<td>$2,370,500</td>
</tr>
<tr>
<td>Per Cent Return on</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Investment</td>
<td>15.45</td>
<td>17.54</td>
<td>19.31</td>
</tr>
<tr>
<td>Total Investment</td>
<td>11.71</td>
<td>13.29</td>
<td>14.63</td>
</tr>
<tr>
<td>Payout Period (with depreciation included)</td>
<td>6.5 years</td>
<td>5.7 years</td>
<td>5.2 years</td>
</tr>
</tbody>
</table>

¹ Based on the new corporation taxes for 1964.
FIGURE 1
BREAK-EVEN CHART FOR WOOD PARTICLEBOARD PLANT NO. 1
(Based on annual production of 17.6 million sq. ft. on a 3/4 in.
thickness basis, at a selling price of $150 per 1,000 sq. ft.)

SALES AND COSTS ($1,000)

SALES

BREAK-EVEN POINT
FOR TOTAL COSTS:
7,600,000 SQ. FT.

BREAK-EVEN POINT
FOR OUT-OF-
POCKET COSTS:
5,400,000 SQ. FT.

TOTAL COSTS

TOTAL OUT-OF-
POCKET COSTS

VARIABLE COSTS

OUTPUT (1,000 SQ. FT.)
Macdonald Associates Process  
5' x 10' x 12 openings  
24,300,000 square feet per year, 3/4-inch basis  
Based on 22.5 productive hours per day and 300 working days a year

A. Estimated Fixed Investment

1. Building
   Manufacturing and warehousing area  
   \[160' \times 260' = 41,600 \text{ sq. ft.} @ \$5.00/\text{sq. ft.}\]  
   $208,000
   Wood preparation building  
   \[50' \times 120' = 9,000 \text{ sq. ft.} @ \$5.00/\text{sq. ft.}\]  
   45,000
   Sheds for barker and chip storage  
   \[12,600 \text{ sq. ft.} @ \$2.00/\text{sq. ft.}\]  
   25,200
   Foundation  
   12,500
   Site preparation  
   9,300
   \[\text{Total Fixed Investment} \quad \$300,000\]

2. Macdonald Automatic System
   All equipment, freight, erection and initial operation  
   $1,252,450

3. Auxiliary Equipment, including fork lift trucks; storage for glue, wax and oil; heating and ventilating equipment; miscellaneous saws and packaging equipment; and laboratory facilities  
   \[420,000\]
   \[\text{Total Fixed Investment} \quad \$1,972,450\]

B. Operational Conditions

1. Product -- 40 pounds per cubic foot, trimmed and sanded, 3-layer and homogeneous flakeboard
2. Press cycle -- minimum 9 minutes
3. Wood raw material -- cordwood or other solid wood material, about 85 cords of green wood per day (2,739 pounds of dry wood per cord) for optimum operation
4. Labor -- 42 man days per 24 hours
C. **Estimated Production Costs**  
(Per 1,000 sq. ft. on a 3/4-inch thickness basis)

1. **Raw Material Costs**
   - **Wood costs**  
     \[ \text{Wood costs} = 1.19 \text{ cords/M sq. ft. @ $15.00/cord} \]  
     \[ = 1.19 \times 15.00 = $17.85/\text{M sq. ft.} \]
   - **Resin costs**  
     \[ \text{Resin costs} = 183# \text{ UF @ 6% to 10% content/M sq. ft. @ $0.125/lb.} \]  
     \[ = 183 \times 0.125 = $22.87/\text{M sq. ft.} \]
   - **Wax emulsion**  
     \[ \text{Wax emulsion} = 15.3#/\text{M sq. ft. @ $0.09/lb.} \]  
     \[ = 15.3 \times 0.09 = $1.38/\text{M sq. ft.} \]
   - **Catalyst costs**  
     \[ \text{Catalyst costs} = 16.2#/\text{M sq. ft. @ $0.10/lb.} \]  
     \[ = 16.2 \times 0.10 = $1.62/\text{M sq. ft.} \]
   - **Total Raw Material Costs**  
     \[ \text{Total Raw Material Costs} = $43.72/\text{M sq. ft.} \]

2. **Utility Costs**
   - **Fuel and oil**  
     \[ \text{Fuel and oil} = 25.3 \text{ gal./M sq. ft. @ $0.095/gal.} \]  
     \[ = 25.3 \times 0.095 = $2.40/\text{M sq. ft.} \]
   - **Power**  
     \[ \text{Power} = 250 \text{ kwh/M sq. ft. @ $0.02/kwh} \]  
     \[ = 250 \times 0.02 = $5.00/\text{M sq. ft.} \]
   - **Steam**  
     \[ \text{Steam} = 1,750#/\text{M sq. ft. @ $0.50/1,000 lbs.} \]  
     \[ = $0.88/\text{M sq. ft.} \]
   - **Total Utility Costs**  
     \[ \text{Total Utility Costs} = $8.28/\text{M sq. ft.} \]

3. **Direct Labor Costs**
   - **336 man hours per day or 4.2 man hours/M sq. ft. @ $2.25/hour**  
     \[ 4.2 \times 2.25 = $9.45/\text{M sq. ft.} \]

4. **Other Fixed Costs**
   - **Depreciation** -- building at 20 years and equipment at 10 years
   - **Maintenance and supplies** -- at 3% of fixed investment
   - **Property taxes** -- at 1% of fixed investment
   - **Insurance** -- at 1% of fixed investment
   - **Selling expense** -- at 5% of gross sales
   - **Administration** -- at 5% of manufacturing costs
   - **Interest rate** -- at 6% of total investment
D. **Estimated Working Capital**

1. One month's glue supply $52,400  
2. Three months' wood supply 108,400  
3. One month's finished goods 300,000  
4. One month's invoices payable $300,000  
   Total $760,800
Table 14

ESTIMATED COSTS AND RETURNS OF WOOD PARTICLEBOARD PLANT NO. 2

(Based on annual production of 24.3 million sq. ft. on a 3/4-in. thickness basis and on a 3-shift operation, 300 days a year)

<table>
<thead>
<tr>
<th>Mill Sale Price (f.o.b. mill/1,000 square feet):</th>
<th>$140.00</th>
<th>$145.00</th>
<th>$150.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Sales</td>
<td>$3,402,000</td>
<td>$3,523,500</td>
<td>$3,645,000</td>
</tr>
<tr>
<td><strong>Variable Costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per 1,000 sq. ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw Materials</td>
<td>$43.72</td>
<td>$1,062,396</td>
<td>$1,062,396</td>
</tr>
<tr>
<td>Utilities</td>
<td>8.28</td>
<td>201,204</td>
<td>201,204</td>
</tr>
<tr>
<td>Direct Labor</td>
<td>9.45</td>
<td>229,635</td>
<td>229,635</td>
</tr>
<tr>
<td>Total</td>
<td>$61.45</td>
<td>$1,493,235</td>
<td>$1,493,235</td>
</tr>
<tr>
<td>Variable Profit</td>
<td>$1,908,765</td>
<td>$2,030,265</td>
<td>$2,151,765</td>
</tr>
<tr>
<td><strong>Fixed Costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-of-Pocket Fixed Costs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>$ 59,174</td>
<td>$ 59,174</td>
<td>$ 59,174</td>
</tr>
<tr>
<td>Property Taxes</td>
<td>19,724</td>
<td>19,724</td>
<td>19,724</td>
</tr>
<tr>
<td>Insurance</td>
<td>19,724</td>
<td>19,724</td>
<td>19,724</td>
</tr>
<tr>
<td>Interest</td>
<td>163,995</td>
<td>163,993</td>
<td>163,995</td>
</tr>
<tr>
<td>Selling Expense</td>
<td>170,100</td>
<td>176,175</td>
<td>182,250</td>
</tr>
<tr>
<td>Administration</td>
<td>96,905</td>
<td>96,905</td>
<td>96,905</td>
</tr>
<tr>
<td>Total</td>
<td>$ 529,622</td>
<td>$ 535,697</td>
<td>$ 541,772</td>
</tr>
<tr>
<td>Cash Income</td>
<td>$1,379,143</td>
<td>$1,494,568</td>
<td>$1,609,993</td>
</tr>
<tr>
<td>Non-Fund Fixed Cost:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>$ 182,245</td>
<td>$ 182,245</td>
<td>$ 182,245</td>
</tr>
<tr>
<td>Net Income before Taxes</td>
<td>$1,196,898</td>
<td>$1,312,323</td>
<td>$1,427,748</td>
</tr>
</tbody>
</table>
Table 15

SUMMARY STATEMENT OF ESTIMATED COSTS AND RETURNS
OF WOOD PARTICLEBOARD PLANT NO. 2

(Based on annual production of 24.3 million sq. ft. on a 3/4-in. thickness basis and on a 3-shift operation, 300 days a year)

<table>
<thead>
<tr>
<th>Mill Sale Price (f.o.b. mil/1,000 square feet):</th>
<th>$140.00</th>
<th>$145.00</th>
<th>$150.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Sales</td>
<td>$3,402,000</td>
<td>$3,523,000</td>
<td>$3,645,000</td>
</tr>
<tr>
<td>Variable Costs</td>
<td>1,493,235</td>
<td>1,493,235</td>
<td>1,493,235</td>
</tr>
<tr>
<td>Variable Profit</td>
<td>$1,908,765</td>
<td>$2,032,265</td>
<td>$2,151,765</td>
</tr>
<tr>
<td>Out-of-Pocket Fixed Costs</td>
<td>529,622</td>
<td>535,697</td>
<td>541,772</td>
</tr>
<tr>
<td>Cash Income</td>
<td>$1,379,143</td>
<td>$1,494,568</td>
<td>$1,609,993</td>
</tr>
<tr>
<td>Depreciation</td>
<td>182,245</td>
<td>182,245</td>
<td>182,245</td>
</tr>
<tr>
<td>Net Income before Taxes</td>
<td>$1,196,898</td>
<td>$1,312,323</td>
<td>$1,427,748</td>
</tr>
<tr>
<td>Taxes, Federal (50%)</td>
<td>598,449</td>
<td>656,161</td>
<td>713,874</td>
</tr>
<tr>
<td>State (5%)</td>
<td>59,845</td>
<td>65,616</td>
<td>71,387</td>
</tr>
<tr>
<td>Net Income after Taxes</td>
<td>$ 538,604</td>
<td>$ 590,546</td>
<td>$ 642,487</td>
</tr>
</tbody>
</table>

| Investment                                    |         |         |         |
| Fixed Investment                              | $1,972,450 | $1,972,450 | $1,972,450 |
| Working Capital                               | 760,800  | 760,800  | 760,800  |
| Total                                        | $2,733,250 | $2,733,250 | $2,733,250 |

| Per Cent Return on                            |         |         |         |
| Fixed Investment                              | 27.31   | 29.94   | 35.57   |
| Total Investment                              | 19.71   | 21.61   | 23.51   |

| Payout Period (with depreciation included)    | 3.7 years | 3.3 years | 3.1 years |

1/ Based on the new corporation taxes for 1964.
FIGURE 2
BREAK-EVEN CHART FOR WOOD PARTICLEBOARD PLANT NO. 2
(Based on annual production of 24.3 million sq. ft. on a 3/4 in. thickness basis, at a selling price of $150 per 1,000 sq. ft.)

SALES AND COSTS ($1,000)

BREAK-EVEN POINT FOR TOTAL COSTS: 8,100,000 SQ. FT.

BREAK-EVEN POINT FOR OUT-OF-POCKET COSTS: 6,100,000 SQ. FT.

OUTPUT (1,000 SQ. FT.)

SALES

TOTAL COSTS

TOTAL OUT-OF-POCKET COSTS

VARIABLE COSTS

Industrial Development Division
Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
APPENDICES
### Appendix 1

**SPECIFICATIONS DEFINING PHYSICAL PROPERTY REQUIREMENTS OF MAT-FORMED WOOD PARTICLEBOARD FOR INTERIOR USE**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Tolerance</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness, inches</td>
<td>1/8 - 1-3/8</td>
<td>1/16 - 1/8</td>
<td>ASTM D-1037-56T</td>
</tr>
<tr>
<td>Size, feet</td>
<td>4 ft. by 8 ft.</td>
<td>--</td>
<td>ASTM D-1037-56T</td>
</tr>
<tr>
<td></td>
<td>or larger</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture content %</td>
<td>5 - 10%</td>
<td></td>
<td>ASTM D-1037-60T</td>
</tr>
<tr>
<td>(as shipped from mill)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>Stated by the</td>
<td>+ 10%</td>
<td>ASTM D-1037</td>
</tr>
<tr>
<td></td>
<td>manufacturer</td>
<td>- 5%</td>
<td>Section 86</td>
</tr>
<tr>
<td>Modulus of rupture lbs./sq. in.</td>
<td>1450 -</td>
<td></td>
<td>ASTM D-1037</td>
</tr>
<tr>
<td>(flexural strength)</td>
<td>1600 psi</td>
<td></td>
<td>Section 10-19</td>
</tr>
<tr>
<td>Modulus of elasticity lbs./sq. in.</td>
<td>200,000 -</td>
<td></td>
<td>ASTM D-1037</td>
</tr>
<tr>
<td></td>
<td>250,000 psi</td>
<td></td>
<td>Section 10-19</td>
</tr>
<tr>
<td>Internal bond lbs./sq. in.</td>
<td>50 - 60 psi</td>
<td></td>
<td>ASTM D-1037</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Section 27-31</td>
</tr>
<tr>
<td>Dimensional stability %</td>
<td>0.50%</td>
<td></td>
<td>ASTM D-1037</td>
</tr>
<tr>
<td>linear expansion %</td>
<td></td>
<td></td>
<td>Section 76-79</td>
</tr>
<tr>
<td>Screw holding (face) minimum lbs.</td>
<td>200 lbs.</td>
<td>--</td>
<td>ASTM D-1037</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Section 88-94</td>
</tr>
<tr>
<td>Screw holding (edge) minimum lbs.</td>
<td>130 lbs.</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

### Appendix 2

**SPECIFICATIONS DEFINING PHYSICAL PROPERTY REQUIREMENTS OF MAT-FORMED WOOD PARTICLEBOARD FOR FLOOR UNDERLAYMENT**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Tolerance</th>
<th>Test Method¹/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness, inches</td>
<td>1/4 in. to 3/4 in.</td>
<td>± 0.010 in.</td>
<td>ASTM D-1037-56T</td>
</tr>
<tr>
<td>Size, feet</td>
<td></td>
<td>± 0.00 in. - 1/8 in.</td>
<td>ASTM D-1037-56T</td>
</tr>
<tr>
<td></td>
<td>2 ft. by 4 ft.</td>
<td>Sec. 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 ft. by 4 ft.</td>
<td></td>
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<td></td>
<td>4 ft. by 8 ft.</td>
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</tr>
<tr>
<td>Moisture content</td>
<td>7% avg.</td>
<td>± 2</td>
<td>ASTM D-1037-56T</td>
</tr>
<tr>
<td>% (as shipped from mill)</td>
<td></td>
<td>Sec. 8, 86, 87(a)</td>
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</tr>
<tr>
<td>Density</td>
<td>40 min. avg.</td>
<td>No single test value less than 38</td>
<td></td>
</tr>
<tr>
<td>Modulus of rupture</td>
<td>1,600 psi min. avg.</td>
<td>No single test value less than 1,450 psi (excepting Sec. 12)</td>
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</tr>
<tr>
<td>lbs./sq. in. (flexural strength)</td>
<td></td>
<td>ASTM D-1037-56T Sec. 10-19</td>
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</tr>
<tr>
<td>Modulus of elasticity</td>
<td>250,000 psi min. avg.</td>
<td>No single test value less than 200,000 psi (excepting Sec. 12)</td>
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<tr>
<td>lbs./sq. in.</td>
<td></td>
<td>ASTM D-1037-56T Sec. 10-19</td>
<td></td>
</tr>
<tr>
<td>Internal bond</td>
<td>70 psi min. avg.</td>
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<tr>
<td>lbs./sq. in. tension strength</td>
<td></td>
<td>ASTM D-1037-56T Sec. 27-32</td>
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</tr>
<tr>
<td>(perpendicular to surface)</td>
<td></td>
<td></td>
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<tr>
<td>Hardness, pounds</td>
<td>500 lbs. min. avg.</td>
<td>No single test value less than 450 lbs.</td>
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<tr>
<td>Dimensional stability³/</td>
<td>0.35% max. avg.</td>
<td>--</td>
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<tr>
<td>linear expansion (%)</td>
<td></td>
<td>Sec. 76-79</td>
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</tr>
<tr>
<td>Water absorption⁴/</td>
<td></td>
<td>--</td>
<td>ASTM D-1037-56T</td>
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<tr>
<td>weight increase (%)</td>
<td>6% max. avg.</td>
<td>Sec. 69-75</td>
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<tr>
<td>2 hours</td>
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<tr>
<td>24 hours</td>
<td>15% max. avg.</td>
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<tr>
<td>Swelling-thickness increase (%)</td>
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<tr>
<td>2 hours</td>
<td>5% max. avg.</td>
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<tr>
<td>24 hours</td>
<td>10% max. avg.</td>
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<tr>
<td>Squareness⁵/</td>
<td>1/8 in. max.</td>
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</tr>
<tr>
<td>Straightness⁶/</td>
<td>1/16 in. max.</td>
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</table>
1/ Five individual specimens required for all tests.
2/ Board density based on volume and moisture content at time of shipment.
3/ Specimen shall be conditioned at 50% and at 90% relative humidity. Conditioning shall continue at each humidity until practical equilibrium is reached.
4/ Specimen shall be submerged in accordance with the alternate method -- horizontally under 1 in. of water.
5/ Squareness shall be determined by measuring the deviation between the two diagonal measurements of trimmed panels.
6/ Straightness is determined by measuring the maximum deviation from a straight line extending from corner to corner on the same trimmed edge.

### Appendix 3

TRUCKLOAD RATES IN CENTS PER HUNDRED POUNDS FOR WOOD PARTICLEBOARD SHIPMENTS IN THE UNITED STATES, 1964

(Medium density board weighing 47 pounds per cubic foot)

<table>
<thead>
<tr>
<th></th>
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<td>80</td>
<td>88</td>
<td>78</td>
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<tr>
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<td>83</td>
<td>64</td>
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<td>42</td>
<td>37</td>
<td>56</td>
<td>54</td>
<td>71</td>
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<td>92</td>
<td>92</td>
<td>47</td>
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<td>51</td>
<td>33</td>
<td>50</td>
<td>51</td>
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<td>Wilmington, N. C.</td>
<td>92</td>
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<td>70</td>
<td>71</td>
<td>65</td>
<td>53</td>
<td>42</td>
<td>33</td>
<td>95</td>
<td>200</td>
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</table>

** Charleston, S. C.**
- 75
- 88
- 61
- 83
- 90
- 80
- 75
- 80
- 67
- 181
- 558

** Columbia, S. C.**
- 69
- 78
- 67
- 78
- 85
- 63
- 65
- 75
- 67
- 75
- 176
- 558

** Augusta, Ga.**
- 40
- 102
- 70
- 92
- 80
- 93
- 80
- 93
- 116
- 487

** Columbus, Ga.**
- 51
- 43
- 57
- 106
- 117
- 80
- 95
- 104
- 67
- 128
- 511

** Macon, Ga.**
- 52
- 43
- 75
- 105
- 117
- 80
- 95
- 104
- 67
- 128
- 511

** Rome, Ga.**
- 62
- 70
- 39
- 92
- 102
- 83
- 85
- 90
- 80
- 170
- 558

** Savannah, Ga.**
- 59
- 64
- 46
- 110
- 117
- 97
- 102
- 108
- 99
- 156
- 511

** Valdosta, Ga.**
- 72
- 61
- 90
- 114
- 128
- 92
- 104
- 121
- 114
- 109
- 487

** Mobile, Ala.**
- 95
- 83
- 102
- 137
- 146
- 117
- 125
- 141
- 134
- 110
- 97
- 487

** Montgomery, Ala.**
- 72
- 58
- 80
- 117
- 128
- 97
- 105
- 121
- 114
- 92
- 109
- 487

** Tuscaloosa, Ala.**
- 80
- 60
- 95
- 121
- 132
- 99
- 105
- 121
- 121
- 75
- 109
- 487

** Jacksonville, Fla.**
- 80
- 58
- 90
- 112
- 128
- 107
- 115
- 131
- 114
- 108
- 109
- 487

** Tallahassee, Fla.**
- 78
- 75
- 65
- 119
- 125
- 104
- 110
- 117
- 108
- 105
- 150
- 558

** Tampa, Fla.**
- 99
- 102
- 80
- 130
- 137
- 119
- 125
- 117
- 128
- 185
- 558

Jackson, Miss.
- 104
- 92
- 110
- 141
- 150
- 121
- 132
- 146
- 141
- 110
- 69
- 465

** Meridian, Miss.**
- 92
- 80
- 99
- 132
- 144
- 110
- 121
- 137
- 130
- 99
- 86
- 468

New Orleans, La.
- 110
- 99
- 117
- 148
- 159
- 132
- 141
- 152
- 148
- 121
- 95
- 465

---

** Absolute freight advantage area:** At least one or more Georgia starting points have the lowest rate to a specific termination.

** Relative freight advantage area:**
1. Any Georgia starting point is not to be higher in rate than any competing location by 16c per 100 lbs. or $5 per 1,000 square feet, and
2. Any Georgia starting point is not to be higher in rate than two competing locations.
Appendix 4

CARLOAD RATES IN CENTS PER HUNDRED POUNDS FOR WOOD PARTICLEBOARD SHIPMENTS IN THE UNITED STATES, 1964
(Medium density board weighing 47 pounds per cubic foot)

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>* Asheville, N. C.</td>
<td>25</td>
<td>26½</td>
<td>32½</td>
<td>25</td>
<td>34½</td>
<td>15</td>
<td>20</td>
<td>32</td>
<td>30</td>
<td>15</td>
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<td>230</td>
</tr>
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<td>28½</td>
<td>28</td>
<td>20</td>
<td>26½</td>
<td>17½</td>
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<td>20½</td>
<td>23</td>
<td>90</td>
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<td>15½</td>
<td>15½</td>
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<tr>
<td>** Charleston, S. C.</td>
<td>24½</td>
<td>32½</td>
<td>18½</td>
<td>29</td>
<td>33½</td>
<td>27½</td>
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<td>21</td>
<td>35½</td>
<td>90</td>
<td>240</td>
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<td>26½</td>
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<td>49½</td>
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<td>38½</td>
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<td>45</td>
<td>39½</td>
<td>23½</td>
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<td>46½</td>
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<td>64½</td>
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</tr>
<tr>
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</tr>
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<td>47½</td>
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<td>41½</td>
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</tr>
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</tr>
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<td>60½</td>
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<td>41½</td>
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</tr>
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<td>59</td>
<td>65</td>
<td>62½</td>
<td>52</td>
<td>49½</td>
<td>188</td>
</tr>
</tbody>
</table>

* Absolute freight advantage area: At least one or more Georgia starting points have the lowest rate to a specific termination.

** Relative freight advantage area: (1) Any Georgia starting point is not to be higher in rate than any competing location by 7c per 100 lbs. or $2 per 1,000 square feet, and

(2) Any Georgia starting point is not to be higher in rate than two competing locations.
Appendix 5

THE PROCEDURE USED IN ESTIMATING THE WOOD PARTICLEBOARD MARKET IN SIX SOUTHERN STATES, 1963 AND 1964

I. Calculated each state's percentage of the combined value added by manufacture of wood furniture, not upholstered (SIC 2511), metal household furniture (SIC 2514), and household furniture, n.e.c. (SIC 2519) in the United States. SIC 2511 + SIC 2514 + SIC 2519 = SIC 251 - (SIC 2512 + SIC 2515).

<table>
<thead>
<tr>
<th>State</th>
<th>Value Added by Manufacture, 1958 (in thousands of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>251 Household Furniture, not Upholstered</td>
</tr>
<tr>
<td>Alabama</td>
<td>13,797</td>
</tr>
<tr>
<td>Florida</td>
<td>31,195</td>
</tr>
<tr>
<td>Georgia</td>
<td>33,811</td>
</tr>
<tr>
<td>South Carolina</td>
<td>12,992</td>
</tr>
<tr>
<td>Tennessee</td>
<td>56,244</td>
</tr>
<tr>
<td>Mississippi</td>
<td>26,946</td>
</tr>
<tr>
<td>UNITED STATES</td>
<td>1,579,626</td>
</tr>
</tbody>
</table>

*Estimated, data not available

II. Calculated each state’s percentage of the number of houses with basement or crawl space in the United States.

<table>
<thead>
<tr>
<th>State</th>
<th>Total Private Nonfarm Housing Starts, 1962</th>
<th>Per Cent of Single-Family Houses with Basement or Crawl Space, 1962</th>
<th>Number of Houses with Basement or Crawl Space, 1962</th>
<th>Per Cent of the United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>23,300</td>
<td>30</td>
<td>6,990</td>
<td>0.89</td>
</tr>
<tr>
<td>Florida</td>
<td>70,200</td>
<td>7</td>
<td>4,914</td>
<td>0.63</td>
</tr>
<tr>
<td>Georgia</td>
<td>39,800</td>
<td>60</td>
<td>23,880</td>
<td>3.05</td>
</tr>
<tr>
<td>South Carolina</td>
<td>14,700</td>
<td>74</td>
<td>10,878</td>
<td>1.39</td>
</tr>
<tr>
<td>Tennessee</td>
<td>22,100</td>
<td>53</td>
<td>11,713</td>
<td>2.56</td>
</tr>
<tr>
<td>Mississippi</td>
<td>19,200</td>
<td>30</td>
<td>5,760</td>
<td>0.73</td>
</tr>
<tr>
<td>UNITED STATES</td>
<td>1,450,900</td>
<td>54</td>
<td>783,486</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Sources: National Association of Home Builders and Forest Products Marketing Branch, Division of Forest Economics, U. S. Department of Agriculture

III. The national production of wood particleboard is given:

<table>
<thead>
<tr>
<th></th>
<th>1963 (In sq. ft. on 3/4-inch basis)</th>
<th>1964* (In sq. ft. on 3/4-inch basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U. S. total production</td>
<td>494,388,000</td>
<td>593,000,000</td>
</tr>
<tr>
<td>Furniture and fixtures</td>
<td>372,860,000</td>
<td>427,000,000</td>
</tr>
<tr>
<td>Floor underlayment</td>
<td>121,528,000</td>
<td>166,000,000</td>
</tr>
</tbody>
</table>

*Estimated
Appendix 5 (continued)

IV. Multiplied the state percentages in Section I and Section II by the given national production for furniture and fixtures and floor underlayment in Section III.

ESTIMATED WOOD PARTICLEBOARD MARKET BY OUTLETS IN THE SIX SOUTHERN STATES, 1963 AND 1964
(In 1,000 square feet on 3/4-inch thickness basis)

<table>
<thead>
<tr>
<th>State</th>
<th>1963</th>
<th>1964</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Furniture and Floor Underlayment</td>
<td>Furniture and Floor Underlayment</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Fixtures</td>
</tr>
<tr>
<td>Alabama</td>
<td>5,370</td>
<td>4,288</td>
</tr>
<tr>
<td>Florida</td>
<td>8,484</td>
<td>7,718</td>
</tr>
<tr>
<td>Georgia</td>
<td>8,368</td>
<td>4,661</td>
</tr>
<tr>
<td>South Carolina</td>
<td>6,275</td>
<td>4,586</td>
</tr>
<tr>
<td>Tennessee</td>
<td>14,446</td>
<td>11,335</td>
</tr>
<tr>
<td>Mississippi</td>
<td>6,256</td>
<td>5,369</td>
</tr>
<tr>
<td>UNITED STATES</td>
<td>494,388</td>
<td>372,860</td>
</tr>
</tbody>
</table>
Appendix 6
A PARTIAL LIST OF ENGINEERING FIRMS AND MANUFACTURERS OR SUPPLIERS
OF EQUIPMENT FOR WOOD PARTICLEBOARD IN THE UNITED STATES

Albert Switzer Associates, 3150 Valley St., Baton Rouge, Louisiana
The Cardwell Machine Company, P. O. Box 1359, Richmond 11, Virginia
Chapwood, Inc., Corvallis, Oregon
Columbia Engineering Company, 209 Cress Bldg., Corvallis, Oregon
The Dean Company, 666 Lake Shore Drive, Chicago 11, Illinois
Industrial Development Corporation, 3011 South Chandler St., Tacoma, Washington
Johnson and Johnson, Engineers and Architects, 111 W. Washington St., Chicago, Illinois
The Kroehler Manufacturing Company, Meridian, Mississippi
The Lane Company, Inc., Altavista, Virginia
Macdonald Associates, Inc., 19/20 Hout Building, Corvallis, Oregon
Miller-Hofft Company, P. O. Box 8718, Richmond 26, Virginia
Rust Engineering Company, 930 Fort Duquesne Boulevard, Pittsburgh, Pennsylvania
Soderhamm Machine Manufacturing Company, Talladega, Alabama
Washington Iron Works, 1500 Sixth Ave., S., Seattle 4, Washington
Wilco Machine Works, P. O. Box 30145, Metropolitan Airport, Memphis, Tennessee
APPENDIX 7
A LIST OF ACTIVE WOOD PARTICLEBOARD PLANTS IN THE U. S., 1964

Listings with (*) are from last available information. New data not furnished.

AMERICAN FURNITURE CO. INC.
Home Address: Starling Ave., Martinsville, Va.
Plant Address: Email, Martinsville, Va.
Production: (Rated Annual Capacity) 10,000,000 sq. ft. 13/16" basis.
1962 Production: 7,171,265 sq. ft.
1962 Rated Daily Capacity: 45 tons
Process: Lane Wood Extruder
Panel Sizes: 45" x 8'
Percent Into Cut-Up Sizes: 100%
Thicknesses: 13/16, 15/16, 17/17, 3/4" basis.
Raw Material Used: Wood chips
Volume (mill residues): 11,700 tons annually
Spec. Gravity: .65
Colors: Natural
Trade Name: Particle Board.
Uses: Core stock, furniture stock, underlayment, cabinet stock.

AMERICAN PARBOARD DIV.
American Liberty Oil
Home Address: Box 8105, Dallas, Texas.
Plant Address: Black Mountain, North Carolina
Production: (Rated Annual Capacity) 12,000,000 sq. ft. 3/4" basis.
1962 Production: 9,000,000 sq. ft.
1962 Rated Daily Capacity: 60 tons
Process: Plate
Panel Sizes: 4' x 8'
Percent Into Cut-Up Sizes: 70%
Thicknesses: 1/2" to 1-3/16" basis.
Volume (mill residues): 50 Tons (from logs) 50 Tons.
Trade Agents: Parboard, Portlakte
Uses: Furniture, solid core doors, partitions, church & school furnish.
Percent of Product for Own Use: Specialty Items: Core stock, furniture stock, underlayment, cut-to-size, cabinet stock.
Sales Agents: L.M. Forest, R. E. Loube.

THE BERKLINE CORP.
Home Address: P.O. Box 100, Morristown, Tenn.
Plant Address: Trade St., Morristown, Tenn.
Personnel: Jacob Popkin, pres.; Howard Westhaver, sm., mgr.; Clifford Rice, suppl.; Mel Margolin, asst. sm., mgr.; Don Gandy, tech. dir.; Frank Magill, plant eng.
Production: (Rated Annual Capacity) 1,800,000 sq. ft. 9/16" basis.
1962 Production: 800,000 sq. ft.
1962 Rated Daily Capacity: 90 tons
Process: Horizontal Extrusion
Panel Sizes: 45" width—variable lengths
Percent Into Cut-Up Sizes: 100%
Thicknesses: 9/16" basis.
Raw Material Used: Oak chips
Volume (mill residues): 1,450 tons annually
Spec. Gravity: .80
Colors: Natural
Uses: Veneered furniture parts
Percent of Product for Own Use: Specialty Items: Core stock, furniture stock, veneer overlay.

BIG BEAR BOARD PRODUCTS INC.
Home Address: Box 128, Redsands, Calif.
Plant Address: Tom Neering, pres.; Donald E. Lengel, gen. & sales mgr.; Carl Weiser, asst. sm., suppl.; Paul Walsh, tech. dir.
Production: (Rated Annual Capacity) 9,000,000 sq. ft. 3/4" basis.
1962 Production: 7,500,000 sq. ft.
Process: Millier-Moffat
Panel Sizes: 4" x 8'
Percent Into Cut-Up Sizes: 90%
Thicknesses: 3/8" to 1-1/2" basis.
Raw Material Used: Pine planer shavings
Volume (mill residues): 1,100 tons annually
Spec. Gravity: Air Dry Density: Dina-Shaw 51# & 47#
Trade Names: Dina-Shaw and Shaw-Bond.
Uses: Furniture and dinette trade, tile underlayment.
Percent of Product for Own Use: None
Specialty Items: Core stock, underlayment, cut-to-size, cabinet stock.
Sales Agents: Carolina Pacific Sales, Inc., Wilmington, N. C.

CASCADE FIBER COMPANY
Home Address: 50 N. Danebo Ave., Eugene, Ore.
Plant Address: Eugene, Ore.
Personnel: L. L. Stewart, pres.; Don McCallum, supt.; Paul Walsh, tech. dir.
Production: (Rated Annual Capacity) 22,000,000 sq. ft. 3/4" basis.
1962 Production: 4,000,000 sq. ft.
Rated Daily Capacity: 75 tons
Process: Cascade II, Process Panel Sizes: Up to 54" x 192".
Percent Into Cut-Up Sizes: As needed.
Thicknesses: 3/8"-3/4" basis.
Raw Material Used: Douglas fir planer shavings and chips
Volume (mill residues): 25,000 tons annually
Spec. Gravity: .55-.80
Colors: Natural
Trade Names: Firlak, Fircraft
Uses: Construction and industrial applications.
Characteristics: Fine surfaced, low & high density constructions.
Percent of Product for Own Use: None
Specialty Items: Core stock, furniture stock, underlayment, cut-to-size, cabinet stock, veneer overlay, prefilt, siding.

CLEAR FIR PRODUCTS OF OREGON LTD.
Home Address: Box 189, Springfield, Oregon.
Plant Address: Springfield, Ore.
Production: (Rated Annual Capacity) 10,000,000 sq. ft. 3/4" basis.
1962 Production: 4,000,000 sq. ft.
Rated Daily Capacity: 28 tons
Process: Dry—Rotation
Panel Sizes: 4'x4' only
Percent Into Cut-Up Sizes: None
Thicknesses: 1/4" only
Raw Material Used: Trim
Volume (mill residues): 6,000 tons annually
Spec. Gravity: .95
Colors: Light tan or veneer color.
Uses: Wall panel, underlayment, utility hardboard applications.
Percent of Product for Own Use: None
Specialty Items: Veneer overlay, construction, decorative, prefilt, siding.

COLLINS PINE COMPANY
Home Address: Terminal Sales Bldg., Portland, Oregon.
Plant Address: Foster, Calif.

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APPENDIX 7 (CONTINUED)

FLAKEBORD CORPORATION
Home Address: Box 1119, James-town, New York
Plant Address: P.O. Box 7, Fulton, N. Y.

Trade Name: Flakeboard. Uses: Furniture core, floor overlay, cabinet stock, underlayment, etc. Percent of Product for Own Use: None. Specialty Items: Core stock, furniture stock, cut-to-size, cabinet stock.

FLAKEBORD CORPORATION
Home Address: Box 1119, James-town, New York
Plant Address: P.O. Box 7, Fulton, N. Y.

DIXIE CHIPBOARD CO.
Home Address: 423 W. Randolph, Chicago, Ill.
Plant Address: P.O. Box 156, Rural Hall, N. C.

DURAFLEX COMPANY
Home Address: 325 Pacific Bldg., Portland, Ore.
Plant Address: P.O. Box 245, Albany, Ore.

DURAFLEX COMPANY
Home Address: 325 Pacific Bldg., Portland, Ore.
Plant Address: P.O. Box 245, Albany, Ore.

DURAFLEX COMPANY
Home Address: 325 Pacific Bldg., Portland, Ore.
Plant Address: P.O. Box 245, Albany, Ore.

DURAFLEX COMPANY
Home Address: 325 Pacific Bldg., Portland, Ore.
Plant Address: P.O. Box 245, Albany, Ore.
APPENDIX 7 (CONTINUED)

Colors: Neutral
Trade Names: Groco Flakecore—
Groco Standard-Groco Under-
leyment.
Uses: Core stock for veneer and
decorative laminates, industrial
door and floor underlayment.
Characteristics: Homogeneous type.
Excellent mechanical & physical
properties. Double sanded.
Percent of Product for Own Use: None.
Specialty Items: Core stock, furnish-
ture stock, underlayment, cut-to-
size, cabinet stock, prefinish, pre-
fill, decorative various industrial
coatings applied.
Sales Agents: J. E. White—J. D.
Winkleblack—T. L. Nestel.

HICKORY MFG. CO.
Home Address: Hickory, N.C.
Plant Address: Hickory, N.C.
Personnel: E. M. Fennell, pres.; J.
J. Johnson, vice-pres. & gen.
mgr.; R. T. Keever, spt.; C. M.
Turbyfill, plant mgr.; L. F. Rome,
sales mgr.; B. Price, plant engr.
Production: (Rated Annual Capac-
ity) 600,000 sq. ft. 8/4" basis.
1962 Production: 594,000 sq. ft.
Rated Daily Capacity: 4½ tons
Process: Batch type.
Panel Sizes: 4'x8" basis
Thicknesses: 3/32" . . . 3/4"
Raw Material Used: Waste chips
from plant
Volume (mill residues): 768 tons
Percent Into Cut-Up Sizes: 90%
Colors: Natural
Spec. Gravity: 0.50 to 1.00
Percent of Product for Own Use: 55%
Specialty Items: Core stock.

INTERNATIONAL PAPER CO.
Long-Bell Division
Home Address: 220 East 42nd St.,
New York, N.Y.
Plant Address: P. O. Box 1079,
Longview, Wash.
Personnel: L. M. Fearing, pres.; T.
A. Deal, mgr.; J. E. Price, spt.; C. E. Miller, s. mgr.; A.
L. Mottet, tech. dir.; M. P. Kurtz,
industrial engr.
Production: (Rated Annual Capac-
ity) 20,000,000 sq. ft. 4/4" basis.
Rated Daily Capacity: 50 tons
Process: Flakeboard
Panel Sizes: 3'x4', 4'x8'
Thicknesses: 1/16" to 1" Raw Material Used: Core-selected softwoods, overlay-selected hard-
wood & softwood veneers & flake.
Spec. Gravity: 0.65 to 1.00
Colors: Natural
Trade Names: Flakewood, Flakewall,
Flakeclad, Prefinished 21 Ven-
O-Wood.
Uses: Decorative wall paneling,
cabinets, core stock, furniture,
industrial millwork.
Characteristics: Durable, high
strength, dimensionally stable,
plain & decorative.
Percent of Product for Own Use: 25%
Specialty Items: Core stock, furnish-
ture stock, cut-to-size, veneer
overlay, paper or plastic overlay,
cabinet stock.
Sales Agents: National company
offices.

JASPER-AMERICAN MFG. CO.
Home Address: Henderson, Ky.
Plant Address: Henderson, Ky.
Personnel: Thomas L. Mabey, pres.;
Robert Goldsmith, dirs.; L. L. Lam-
pert, s. mgr.; H. E. Thyen, tech. dir.
Production (Rated Annual Capac-
ity): 10,500,000 sq. ft. 11/16" basis.
1962 Production: 5,500,000 sq. ft.
Rated Daily Capacity: 50 tons
Process: Pressing
Percent Into Cut-Up Sizes: 85%
Thicknesses: 1/16" to 1" Raw Materials Used: Pine
Volume (mill residues): 10,000 tons
Spec. Gravity: .65
Colors: Light
Trade Names: Craftsmaster Chipcore
Uses: Plywood cores
Characteristics: Vertically oriented
Percent of Product for Own Use: 70%
Specialty Items: Core stock, furni-
ture stock, cut-to-size, veneer
overlay, cabinet stock.

KROEHLER MANUFACTURING CO.
Home Address: Naperville, Ill.
Plant Address: West Station, Meri-
dian, Miss.
Personnel: Kenneth Kroehler, pres.;
Fred E. McFarland, spt.; Walter John-
son, spt.; E. J. McFarland, plant
mgr.
Production: (Rated Annual Capac-
ity) 7,200,000 sq. ft. 3/4" basis.
1962 Production: 2,000,000 sq. ft.
Rated Daily Capacity: 65 tons
Process: Electric—Flake type.
Panel Sizes: 5'x10'
Thicknesses: 1/8", 3/16", 1/4", 3/8" 1, 1 1/4" inches
Raw Material Used: Southern hard-
wood chips
Volume (mill residues): 15,600 tons
Spec. Gravity: .65
Colors: Light Brown
Trade Names: Cultured Wood—
Chevrolet
Uses: Furniture core stock, frame
stock, cabinet doors, television
abinet cores, diinet te table tops.
Characteristics: Dimensionally
stable, excellent screwholing,
high internal bond, tight edge.
Percent of Product for Own Use: 80%
Spec. Specialty Items: Core stock,
furniture stock, cut-to-size, veneer
overlay, paper or plastic overlay,
cabinet stock.

THE LANE COMPANY, INC.
Home Address: Altavista, Va.
Plant Address: Altavista, Va.
Personnel: H. E. Lane, Sr., Chairman
of Board; H. G. Powell, pres.; B.
B. Lane, mgr.; F. T. Holland,
plant mgr.; Waverly Davidson,
tech. dir.; R. T. Blanchard, plant
mgr.
Production: (Rated Annual Capac-
ity) 12,000,000 sq. ft. 3/4" basis.
1962 Production: 7,000,000 sq. ft.
Rated Daily Capacity: 25 tons
Process: Laneom Extrusion
Panel Sizes: 4'x8' cut to length
Percent Into Cut-Up Sizes: 100%
Thicknesses: 9/16" to 21/16 inches.
Raw Material Used: Dry mill waste
Volume (mill residues): 6 million
Spec. Gravity: .65
Colors: Natural
Trade Names: Laneom
Uses: Core stock
Characteristics: Dimensionally
stable.
Percent of Product for Own Use: 95%
Specialty Items: Core stock, furnish-
ture stock, cut-to-size, veneer
overlay, cabinet stock.

LESTER CEDAR PRODUCTS INC.
Home Address: Box 465, Sweet
Home, Ore.
Plant Address: Sweet Home, Ore.
Personnel: M. F. Lester, pres. & s. 
mgr.; Mike Lester, spt. & gen.
mgr.; W. A. Steward, plant
mgr.
Production: (Rated Annual Capac-
ity) 7,000,000 sq. ft. 3/8" basis.
1962 Production: 15,000,000 sq. ft.
Rated Daily Capacity: 42 tons
Process: Industrial Developments
Inc.
Panel Sizes: 60x120 inches.
Percent Into Cut-Up Sizes: 10%
Thicknesses: 1/2" to 11/2" Raw Material Used: Alder, Maple & Fir
Volume (mill residues): 4000 tons
Spec. Gravity: .65
Colors: Natural
Trade Names: Cedawood—G. P.
Flakeboard—Lester Flakeboard
Uses: Cabinet furniture, paneling,
punch board, flooring, ceiling tile,
etc.
Characteristics: No warp, decor-
ative, excellent machining, good
strength and screw holding, high
density.
Percent of Product for Own Use: None.
Specialty Items: Core stock, furni-
ture stock, underlayment, cabinet
stock, floor tile, construction,
shoeing, deck panel, decorative,
V-groove, V-2 groove, punch board, fire
retardant, termite repellant.

NORTHBOARD INC.
Plant Address: Atchison, Kan.
Home Address: Iron River, Mich.
Personnel: S. A. McCormack, pres.;
Robert A. Caughey, tech. consultant
Production: To begin production
early 1964
Panel Sizes: 7x8 feet.
Thicknesses: 1/4" to 3/4" Raw Material Used: Aspen
Uses: Core stock, underlayment,
cabinet stock.

NU-WOODS, INC.
Home Address: P. O. Box 706, Len-
oir, N.C.
Plant Address: 205 Horriburg Rd.,
Lenoir, N.C.
Personnel: Harold F. Coffey, pres.;
S. D. Weber, gen. spt. & mgr.;
Fred H. Fulmer, spt.
Production: (Rated Annual Capac-
ity) 6,000,000 sq. ft. 3/4" basis.
1962 Production: 2,512,829 (ap-
erated 7 m.p.)
Rated Daily Capacity: 36 tons
Process: Mill-Holt Platten Process
Panel Sizes: 4'x8' ft.
Percent Into Cut-Up Sizes: 50%
Raw Material Used: Multi-specie
Volume (mill residues) 36 tons per
spec. gravity: .65 to .70
Colors: Natural
Trade Names: Nanga Board
Uses: Core stock for furniture
Percent of Product for Own Use: None
Specialty Items: Core stock, furnish-
ture stock, cut-to-size.

THE PACK RIVER CO.
Home Address: Tenex Inc.
* Home Address: P. O. Box 351, Sand-
point, Idaho
Plant Address: Davenport, Idaho
Personnel: L. V. Brown, pres.; T. E.
O'Donnell, mgr.; Doug Rude, spt.;
T. S. Porter, sales mgr.; D. L.
Haynes, tech., dir.

*Tenex Inc.
APPENDIX 7 (CONTINUED)

SOUTHERN PINE LUMBER CO.
Home Address: Dothan, Texas
Personnel: Arthur Temple, Jr., pres.; G. W. Sweeney, dir.; W. L. Glass, mgr.; Pine-
land Construction; B. E. Mikula, project tech.; R. E. Howard, proj. supervisor; F. D. Johnson, Qua.
ity Supervisor; O. G. Book.
Production: Rated Annual Capacity: 10,000,000 sq. ft. 1/2' basis. 1962 Production: None
Rated Daily Capacity: 50 tons
Uses: Core stock, furniture core, underlayment, cut-to-size, cabinet stock, prefabricated, con-
struction, fully machined furniture parts.

SOUTHERN PLASWOOD CORP.
Affiliate of Emerite Corp., Jackson, Miss.
Home Address: Box 123, Hope, Ark.
Personnel: R. W. Emerson, pres.; George LeClerc,签名; David Hume, mgr.; James Bell, sales
mgr.; L. T. Wood, tech. dir.; W. W. Scott, project engr.
Production: Rated Annual Capacity: 15,000,000 sq. ft. 1/2' basis. 1962 Production: 906,000 so. ft.
Rated Daily Capacity: 54 tons
Uses: Chair backs, seats, panel core-
stock, veneer overlay, paper or plastic overlay, cabinet stock, construction, sheathing, decking.

SUPERWOOD MULTIPLY PLANT
Home Address: 14th Ave. West & Waterfront, Duluth, Minn.
Personnel: J. P. W. Mackay, pres.; L. R. Krause, vice-pres.; R. L. Stephany, stks.; L. W. Leach, dir.;
Plant Operation; B. E. Mikulka, plant engr.
Production: Rated Annual Capacity: 12,000,000 sq. ft. 1/4' basis. 1961 Production: 3,000,000 sq. ft.
Panel Sizes: 4x8 ft.
Thicknesses: 1/8, 3/4, 1 inch
Raw Materials Used: Aspen
Volume (from logs): 12,000 tons annually
Spec. Gravity: .75
Colors: Natural
Trade Name: Superwood Multiply Board
Uses: Underlayment, sheathing and general construction
Percent of Product for Own Use: None
Specialty Items: Underlayment, veneer overlay, paper or plastic overlay, cabinet stock, construction, sheathing, decking.

STANDARD BOARD PRODUCTS INC.
Home Address: Route 1, Box 3364, Sweet Home, Oregon
Personnel: Warren Gill, pres.; Ed Kellenberger, gen. & sales mgr.; Gayle Pulver, sign.; Ray Swope,
tech. dir.; Louis V. Schuldt, plant engr.
Production: Rated Annual Capacity: 240,000,000 sq. ft. 1/8' basis
Process: Mat formed
Panel Sizes: 4x8 ft.
Percent Into Cut-up Sizes: None
Raw Material Used: Green planer shavings
Volume: Begun operation in 1963
Spec Gravity: .68
Trade Names: Standbo and West-
down
Uses: Underlayment
Specialty Items: Underlayment, con-
struction, sheathing, decking.

STARKLINE CORPORATION
Home Address: P.O. Box 492, Jackson, Miss.
son, plant engr.
Production: (Rated Annual Capacity): 906,000 sq. ft. 1/2' basis. 1962 Production: 906,000 sq. ft.
Rated Daily Capacity: 11.2 tons (1 shift)
Process: Own—Multi-plates
Panel Sizes: 4x8 ft.
Percent Into Cut-up Sizes: 100%
Thicknesses: 1/4, 1/2, 3/4, 1 inch
Raw Material Used: Southern hard-
woods
Volume (mill residues): 1,300 tons annually
Spec. Gravity: .8
Colors: Natural
Trade Name: Nu-Tex
Uses: Core stock
Percent of Product for Own Use: 100%
Specialty Items: Core stock, furni-
ture stock, veneer overlay, cabinet stock, cut-to-size.

SWAIN INDUSTRIES INC.
Home Address: West Second St., Seymour, Ind.
Personnel: F. W. Bottorf, pres.; D. Billings, Swain, vice-pres.; Poul Aikman, sign.; L. C. Moore, sec.;
L. J. Heyne, treas.
Production: (Rated Annual Capacity): 10,000,000 sq. ft. 1/4' basis.
Process: Own
Panel Sizes: 2x10, 3x11, 36x10, 36x11, 4x8 ft.
Thicknesses: 1/4, 1/2, 3/4, 1 inch
Raw Material Used: Mixed hard-
woods
Use: CUFI: 42, 45, 48
Trade Name: Trimwood
Uses: Chair backs, seats, panel core-
stock.
APPENDIX 7 (CONTINUED)

TENN-FLAKE CORP.
Home Address: P. O. Box 106, Morristown, Tenn.
Plant Address: Trade Street, Morristown, Tenn.
Production: (Rated Annual Capacity) 10,000,000 sq. ft. 36" basis. 1962 Production: 7,000,000 sq. ft. 
Rated Daily Capacity: 40-45 tons 
Process: Bison System 
Panel Sizes: 5x10', 5x8', 5x10', 5x12' 
Thicknesses: 3/16"-1" inches 
Raw Material Used: Poplar, maple, pine, and gum 
Values (from logs): All 
Spec. Gravity: 0.68 
Trade Name: Tenn-Flake 
Uses: Core material for plywood and plastic laminating, shelvings, cabinets, tables, display cases. 
Characteristics: Multi-layer interlocking layers, wide belt sanded, almost 3 sides. 
Percent of Product for Own Use: None 
Specialty Items: Core stock, furniture stock, cut-to-size, cabinet stock, finished goods. 

UNITED STATES PLYWOOD CORP.
Home Address: 55 West 44th St., New York, N. Y. 
Personnel: W. Allen Wodtli, mg.; & sls. mgr. 
Production: (Rated Annual Capacity) 30,000,000 sq. ft. 36" basis. 1962 Production: 15,004,000 sq. ft. 
Percent Into Cut-Up Sizes: 25% 
Thicknesses: 3/4"-3/8" basis. 
Raw Material Used: Aspen logs 
Values (from logs): 25,000 tons 
Spec. Gravity: 0.63 
Trade Names: Westvaco Flokeboard, Westvaco Dureen 
Uses: Kitchen cabinets, furniture, core stocks, plastic fabrications, store displays, wall partitions. 
Characteristics: Tight edges, high color, high MOR and MOE. 
Percent of Product for Own Use: None 
Specialty Items: Core stock, furniture stock, cut-to-size veneer overlay, paper or plastic overlay, cabinet stock, decorative, hardboard overlays. 

WEYERHAUSEN COMPANY
Wood Products Division 
Home Address: Tacoma Bldg., Tacoma, Wash. 
Plant Address: Arcata, Calif. 
Production: (Rated Annual Capacity) 27,000,000 sq. ft. 36" basis. 
Rated Daily Capacity: 125 tons. 
Process: Bahn system of flake-panel production. 
Panel Sizes: Widths of 51-3/16" to length of 196". 
Percent Into Cut-Up Sizes: 50% 
Thicknesses: 3/4 to 1/2 inches. 
Raw Materials Used: Douglas fir flakes 
Volume (mill residues): 63,000 tons annually. 
Spec. Gravity: 0.65 
Colors: Light to tan 
Trade Name: Timbland 
Uses: Core stock, fixtures, paneling, line includes filled, veneered, phenolic bonded, acryllic bonded, high-density Kimpreg overlaid, fire-retardant treated and toxic treated. 
Characteristics: High strength, resists warping, exceptional edge-gluing strength, excellent machining and sawing characteristics, extreme compactness and smoothness of edges. Engineered wood flake panels. 
Percent of Product for Own Use: None 
Specialty Items: Core stock, furniture stock, veneer overlay, pre-filled & sealed, decorative, fire-retardant treated, termite resistant treated, phenolic for exterior applications. 
Sales Agents: The Weyerhaeuser sales organization, including distribution centers nationwide and independent distributors. 

WEYERHAUSEN COMPANY
Wood Products Division 
Home Address: Tacoma Bldg., Tacoma, Wash. 
Plant Address: Coos Bay, Ore. 
Production: (Rated Annual Capacity) 20,000,000 sq. ft. 36" basis. 1962 Production: 10,904,000 sq. ft. 
Process: Westvaco-Miller-Hoff process 
Panel Sizes: 4x8' and cut-to-size. 
Percent Into Cut-Up Sizes: 25% 
Thicknesses: 3/4"-1/2" basis. 
Raw Material Used: Aspen logs 
Volume (from logs): 25,000 tons 
Spec. Gravity: 0.70 
Trade Names: Westvaco Flokeboard, Westvaco Dureen 
Uses: Kitchen cabinets, furniture, core stocks, plastic fabrications, store displays, wall partitions. 
Characteristics: Tight edges, light color, high MOR and MOE. 
Percent of Product for Own Use: None 
Specialty Items: Core stock, furniture stock, cut-to-size veneer overlay, paper or plastic overlay, cabinet stock, decorative, hardboard overlays.

APPENDIX 7 (CONTINUED)
APPENDIX 7 (CONTINUED)

Production: (Rated Annual Capacity) 20,000,000 sq. ft. 3/4" basis.
Process: Miller-Hofft Multi-platen
Panel Sizes: 4'x8'; also larger sizes by edge gluing.
Thicknesses: 3/8, 1/2, 5/8, 3/4 inches.
Raw Material Used: Green shavings
Spec. Gravity: .65
Colors: Light tan
Trade Name: Versabord
Uses: Floor underlayment, core stock.
Characteristics: Uniform thickness, fastens firmly, resists indentation, uniform density, good surface for bonding.
Percent of Product for Own Use: None
Specialty Items: Edge-Loc Versabord in sizes larger than 4'x8'.
Sales Agents: The Weyerhaeuser sales organization, including distribution centers nationwide and independent distributors.

WOODCORE, INC.
Home Address: P.O. Box 45, Scottsdale, Pa.
Plant Address: Scottsdale, Pa.

Production: (Rated Annual Capacity) 3,500,000 sq. ft. 3/4" basis.
1962 Production: 100,000 sq. ft.
Rated Daily Capacity: 15 tons
Process: Chiperaft Extrusion
Panel Sizes: 4' wide up to 12' long
Percent Into Cut-Up Sizes: None
Thicknesses: 3/16" thru 1/2".
Raw Material Used: Oak-Maple
Volume (mill residues): 150 tons
Spec. Gravity: 40-45-50
Colors: Light brown
Trade Name: ScotBord
Uses: Core stock, underlayment, cut-to-size, veneer overlay, cabinet stock, lumber edge banded.

WYNNEWOOD PRODUCTS CO.
Home Address: P.O. Box 8105, Dallas, Texas.
Plant Address: 303 Tena St., Jacksonville, Texas.
Production: (Rated Annual Capacity) 12,000,000 sq. ft. 3/4" basis
1962 Production: 6,000,000 sq. ft.
Rated Daily Capacity: 60 tons
Process: Platen
Panel Sizes: 4'x8'
Percent Into Cut-Up Sizes: 90%
Thicknesses: 3/16" thru 1 3/4'.
Raw Material Used: Southern Pine shavings
Volume (mill residues): 50,000 tons
Spec. Gravity: Constoc 717; Arcatex 814; WW601 1.01; WW60F 0.97; Dorcor 560; Fincor .752
Colors: Light brown
Trade Names: Wynnewood Constoc, Arcatex, Finecor, Dorcor, 601, 60F.
Uses: Furniture, solid core doors, partitions, church & school furniture.
Characteristics: Six types designed for particular end uses.
Percent of Product for Own Use: None
Specialty Items: Core stock, furniture, stock, cut-to-size, cabinet stock, doors, partitions, edge banding.

Source: Forest Industries, July 1963
Appendix 7 (continued)
SUPPLEMENTARY LIST OF ACTIVE WOOD PARTICLEBOARD PLANTS
IN THE UNITED STATES, 1964

Caldwell Furniture Co.
Plant Address: Lenoir, N. C.
Process: Lane horizontal extrusion
Product: Splinter-type particleboard
Density: Medium
Thickness: 3/4"
Panel Size: 49" wide, any standard panel length
Raw Material: Furniture plant waste
Rated Annual Capacity: 5 million sq. ft. 3/4" basis
Rated Daily Capacity: 40 tons
Press Capacity: 1 extrusion press
Captive Plant

Hart Wood Products
Home Address: Hart, Michigan
Plant Address: Box 27, Hart, Mich.
Personnel: W. L. Tate, President and Manager
Rated Annual Capacity: 3 million sq. ft. 3/4" basis
Product: Splinter board
Process: Extrusion
Captive Plant

Lenoir Chair Company
Plant Address: Newton, N. C.
Lenoir Furniture Corp.
Plant Address: Lenoir, N. C.
(Duplicate operations -- single plant listed below)
Personnel: C. E. Beach, Manager
Process: Lane-Adamson horizontal extrusion
Product: Splinter-type particleboard
Density: Medium
Thickness: 11/16" to 1 5/16"
Panel Size: 48" wide, any standard panel length
Raw Material: Furniture plant waste, mostly hardwood
Rated Annual Capacity: 5 million sq. ft. 3/4" basis
Rated Daily Capacity: 40 tons
Press Capacity: 1 extrusion press
(each plant)
Two Captive Plants

Poinsett Lumber & Mfg. Co.
(The Singer Mfg. Co.)
Home Address: Trumann, Ark.
Plant Address: Trumann, Ark.
Process: Multi-platen
Rated Annual Capacity: 5 million sq. ft. 3/4" basis
Captive Plant

Potlatch Forests, Inc.
Bradley-Southern Division
Plant Address: Warren, Arkansas

Rock Island Corp.
Home Address: 2525 4th Ave., Rock Island, Ill.
Plant Address: Marinette, Wisc.
Personnel: E. R. Titcomb, President
Rated Annual Capacity: 15 million sq. ft. 3/4" basis
Process: Multi-platen
Raw Material: Aspen
Volume: 35,000 cords annually
Specific Gravity: 1:0
Trade Name: Resincore
Date of Completion: 1964 or 1965

Thomason Chipboard Co.
Plant Address: Fayetteville, N. C.
Personnel: J. A. Barnes, Manager; B. H. Thomason, President
Process: Chipcraft vertical extrusion
Product: Splinter-type particleboard
Density: Medium
Thickness: 1 1/8" to 1 9/16"
Panel Size: 48" wide, any standard panel length
Raw Material: Softwoods and hardwoods, mill residues, veneer waste
Rated Annual Capacity: 4 million sq. ft. 3/4" basis
Rated Daily Capacity: 30 tons
Press Capacity: 1 extrusion press
Captive Plant
UNITED STATES PLYWOOD CORP.
Home Address: 55 West 44th St., New York, N. Y.
Plant Address: Gaylord, Mich.
Process: Novoply
Rated Annual Capacity: 40 million sq. ft. 3/4" basis
Scheduled for Production: Spring, 1965

WEST VIRGINIA FOREST PRODUCTS CO.
Home Address: P. O. Box 426, Green-ville, S. C.
Plant Address: Sutton (Braxton County), West Virginia

WILLIAMS FURNITURE CORP.
Home Address: P. O. Box 631, Sumter, S. C.
Plant Address: Fulton & Grant Sts., Sumter, S. C.
Captive Plant

WOOD FIBREBOARD CO.
Home Address: 326 Pacific Building, Portland, Oregon
Plant Address: Old Pacific Highway, P. O. Box 245, Albany, Oregon
Personnel: William Swindles, President