To the Graduate Council:

I am submitting herewith a thesis written by Andrew L. Miller entitled "Yellow-Poplar Veneer in the Southern Pine Plywood Industry." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Forestry.

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YELLOW-POPLAR VENEER IN THE SOUTHERN PINE PLYWOOD INDUSTRY

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Andrew L. Miller

March 1979

1081537

DEDICATION

This thesis is dedicated to the Harold family and the memory of their son and brother, Eric M. Harold.

ACKNOWLEDGMENTS

To Dr. Harold A. Core is extended my sincere gratitude for the consultation and support provided throughout the stages of this study. I also wish to express my appreciation to Dr. Donald A. Stumbo and Dr. Garland R. Wells for their editorial and technical assistance.

I am thankful for the help provided by Dr. William C. Goolsby with the financial portions of this study.

Thanks must also be given to Dr. Monte Harold, Forest Products Specialist, with the Tennessee Valley Authority (TVA). Without his encouragement and support, this study could not have been completed.

My wife, Patti, has provided patience, understanding and considerable time in editing and typing, and for this I am sincerely grateful. To my sons, Paul and Seth, I must apologize for the put-off ball games and fishing trips, and thank them for their cooperation and understanding.

Many other people have provided technical advice and assistance and I appreciate all of the cooperation.

I would like to give special thanks to the TVA for their interest and financial assistance in this study.

ABSTRACT

Yellow-poplar, Liriodendron tulipifera L., is an expanding timber resource of the southern Appalachian region. This resource has the potential to be utilized more completely.

This study was done to examine one possible use of yellow-poplar, as a veneer in the southern pine plywood industry.

In considering this use three main areas were examined: the technical feasibility, resource availability, and the economic feasibility of producing yellow-poplar veneer.

A literature search as well as personal communication and visitation were used to obtain data on the technology involved when using yellow-poplar. Special emphasis was placed on yellow-poplar in relation to its potential use with southern yellow pine.

Resource availability data were obtained from the United States Forest Service and Tennessee Valley Authority and were examined for possible plant locations.

A computer simulation program of the Forest Service was used to examine cost factors. The data, used as inputs, were gathered from information supplied by industry as well as the American Plywood Association.

It was found that an increasing supply of yellow-poplar was occurring in the region studied. This supply was believed to be of high quality which would peel well on a rotary lathe.

The technical problems involved with using yellow-poplar were considered to be insignificant. It was felt that, technically, yellow-poplar could be used in the industry with existing equipment with only minor changes in heating and drying schedules.

Cost factors were found to be comparable to those of southern pine. The cost involved in peeling and using yellow-poplar veneers was not prohibitive.

It was concluded that yellow-poplar veneer was suitable for use as a substitute veneer in the southern pine plywood industry.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION	1
	Objective	1
	Justification	1
	Expansion of the Softwood Plywood Industry	2
II.	TECHNICAL CONSIDERATIONS	5
	Traditional Uses of Yellow-poplar	5
	Tree Characteristics	6
	Wood Characteristics	6
	Plywood Standards	7
	New and Specialty Products	11
	Equipment and Procedures	13
	Yield Data	14
III.	TIMBER RESOURCE	16
	Forest Service Information	16
	TVA Information	16
	Management Practices	17
	Areas of Concentration	19
	Ownership Characteristics	32
	Willingness to Sell	40
IV.	COST ANALYSIS	44
	Cost Assumptions	44
	Simulation Model	44
	Cost Inputs	45

CHAPTER PAGE

Simulation Results 54

V. SUMMARY AND CONCLUSIONS. 55

LITERATURE CITED 58

APPENDIXES 61

APPENDIX A. EQUIPMENT PROPOSAL. 62

APPENDIX B. THE CASH FLOW ANALYSIS PROGRAM (CFA). 67

VITA 75

LIST OF TABLES

TABLE		PAGE
1.	Log and Wood Characteristics and Features of Yellow-poplar	8
2.	Sturd-I-Floor Face and Back Veneer Requirements for Joist Spacing	12
3.	Sawtimber Volume in Millions of Board Feet (Doyle) for the Asheville, North Carolina Area	20
4.	Growing Stock Volume in Millions of Cubic Feet for the Asheville, North Carolina Area	23
5.	Sawtimber Volume in Millions of Board Feet (Doyle) in the Bristol, Tennessee Area	26
6.	Growing Stock Volume in Millions of Cubic Feet for the Bristol, Tennessee Area	29
7.	Commercial Forest Land in Acres for the Asheville, North Carolina Area	33
8.	Commercial Forest Land in Acres for the Bristol, Tennessee Area	36
9.	Percentage of Ownership of Commercial Forest Land for the Asheville, North Carolina and Bristol, Tennessee Areas	39
10.	Programmed Harvest (Current Cutting Practice) for Fiscal 1978, October 1977 to September 1978 by National Forest.	41
11.	Prices for Timber F.O.B. Second and Third Quarter 1977 Averages	43

TABLE PAGE

12. Labor Cost 48

13. Facilities Cost. 52

14. Depreciation Schedule. 53

CHAPTER I

INTRODUCTION

The pine plywood industry requires sufficient raw material of good size, quality, and price to meet its needs. If additional resources could be found to complement and supplement the veneers now used in softwood plywood, a lower cost, better quality product might result. One suggested resource is yellow-poplar, Liriodendron tulipifera L., because of the quality of its veneer and the abundance of its supply.

I. OBJECTIVE

The objective of this study was to examine the economic and technical feasibility of integrating yellow-poplar veneer into the southern pine plywood industry. The problem was divided into three parts. The technical aspects of using yellow-poplar veneer were considered first. Next, the resource availability of yellow-poplar was examined. Lastly, the costs of producing the veneer were determined. Plant investment, estimated for the establishment of a veneer plant within the resource area, was included as part of the production costs.

II. JUSTIFICATION

Yellow-poplar, an important sawtimber species of the southern Appalachian region, is not being fully utilized. Inventory data by both Tennessee Valley Authority (TVA) (9) and the United States

Department of Agriculture (USDA) Forest Service (2) indicate that the physical supply of timber is increasing and that the ratio of yearly growth, over cut, exceeds that of other hardwoods in this region. The fact that both timber growth has increased and timber cut has declined has added to the physical surplus of yellow-poplar since 1950 (2).

The large inventories of yellow-poplar sawtimber along with the apparent decrease in use of this species have stimulated several studies aimed at greater utilization of this resource.[1] One area that has aroused considerable interest as well as the support of TVA has been the possibility of integrating yellow-poplar veneer into the southern pine plywood industry.

III. EXPANSION OF THE SOFTWOOD PLYWOOD INDUSTRY

History shows that the softwood plywood industry has met several challenges since its inception in 1905. The early problem with finding a durable waterproof glue was solved. Economic problems during the Depression of 1929 were overcome. The problems which arose from the rapid growth and demand, coupled with a dwindling old growth Douglas-fir supply, led eventually to the southern pine portion of the industry today. During the 1940's and early 1950's, old growth Douglas-fir was rapidly being depleted. This encouraged the softwood plywood industry

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[1] Marketing and Utilization of Yellow-poplar Symposium. TVA, USDA, Forest Service, the University of Tennessee, Department of Forestry, Fishery, and Wildlife, Knoxville, Tennessee, March 21-22, 1978, 1-182.

to expand its technology from peeling large, relatively defect-free old growth Douglas-fir, to peeling smaller logs containing more defects. In 1950 the first plant east of the Cascade Mountains began operation. This plant, and a series of others which eventually opened, utilized smaller logs, down to 14 inches in diameter. They did this by using faster, more automated lathes which could peel three to five logs per minute. By preconditioning the logs in heated water vats or live steam rooms, these new plywood plants overcame the problems associated with the varied climate and the increased defects of the logs.

The technology for using smaller logs allowed a further expansion in 1963 with the opening of the Georgia-Pacific Company plant in Fordyce, Arkansas using the southern pines. This was the beginning of a mass expansion to the Southeast from the Northwest by the softwood plywood industry.

In the Southeast labor was relatively cheap, markets were nearer, and the supply of 14-inch to 20-inch diameter logs of southern yellow pine was good; however, the use of yellow pines did present problems. The earlywood and latewood density is substantially different, which in turn causes problems in peeling, drying, and more critically, gluing.

Again industry, along with the USDA, Forest Service, Forest Products Laboratory, met the challenge and the technology was developed to overcome the problems caused by the use of yellow pine veneer in plywood construction. This was done by preconditioning the logs, building larger, more automated dryers, faster lathes, and by developing

glue formulas that were more compatible with the higher resin content of southern pine. Also considerable marketing work was done to establish acceptance of yellow pine plywood.

In 1976 the plants using mainly southern yellow pines produced about 40% of the total plywood. In doing so they consumed 166,596,000 square feet of yellow pine veneer, 1-inch basis (5).

Although the softwood plywood industry is well established and its track record is very good, higher log prices and the market encroachment of new products such as particle board, medium density fiberboard and waferboard have placed before the industry another obstacle to overcome. The industry must provide even better products and keep prices competitive in order to continue to expand or to hold its share of the market. For these reasons, new or supplemental sources of raw material such as the low density hardwoods, more precisely, yellow-poplar, could provide an opportunity for expansion.

CHAPTER II

TECHNICAL CONSIDERATIONS

Yellow-poplar is an important species for hardwood lumber and veneer products. Over the years much technical information has been developed on its properties and manufacturing capabilities. In addition, a few studies have been conducted on its use as a potential substitute for southern pine in softwood construction plywood. This information has been reviewed and summarized to support the technical feasibility of utilizing yellow-poplar for this use.

This study does not consider all the specific uses of yellow-poplar. However, in its traditional role as a hardwood veneer, considerable knowledge can be gained from the technical information already established about peeling yellow-poplar veneer.

I. TRADITIONAL USES OF YELLOW-POPLAR

Yellow-poplar veneer has been used for crossbanding and core plys for many years in the hardwood plywood industry (14). It also has been used for face veneer, especially when the panels were intended to be painted or stained (14). Yellow-poplar is free from offensive odor or taste and thus its veneers have been used to make boxes, baskets and containers for foodstuff, and other similar commodities (15).

Yellow-poplar is also a highly desirable veneer in the construction of musical instruments (14). Piano and organ manufacturers use

yellow-poplar extensively in the construction of sounding boards, faces, and backs (14). Also the manufacturers of stringed instruments prize these veneers in their manufacturing process (14).

The rotary veneer lathe was invented and patented in 1840 by John Dresser of Stockbridge, Massachusetts (18). Since the sliced veneers of yellow-poplar were used prior to 1840 (18), the abundance of the species and its peeling quality lend to the assumption that it was used for rotary veneer very early. Considerable information has been compiled on the technology of rotary peeling yellow-poplar veneer.

II. TREE CHARACTERISTICS

Yellow-poplar has a straight, well pruned bole which on the average can supply about 40 feet to 45 feet of stem, which can be peeled on a rotary veneer lathe (14). Diameters, at breast height, on 50 year old to 60 year old trees are usually 18 inches to 24 inches (10). The tree reaches maturity at 200 years of age (10). The maximum age is about 300 years with a maximum diameter of 12 feet (10). These qualities make the tree one of the most desirable eastern hardwoods for rotary cutting on a veneer lathe (14).

III. WOOD CHARACTERISTICS

The properties of the wood also contribute to the qualities which make yellow-poplar a very important veneer species. The sapwood, which is usually two inches to six inches in thickness and whitish in color, surrounds the light yellow-green heartwood (14). The heartwood

is often marked with streaks in the shades of purple, blue, dark green and black (14) that apparently do not affect the physical properties of the wood.

The wood has no characteristic odor or taste (14). It is a straight grained, diffuse-porous wood which is moderately light and moderately soft (14). Table 1 shows log characteristics, physical, mechanical, cutting, and drying characteristics of the species, as summarized by Lutz (14).

IV. PLYWOOD STANDARDS

Plywood Product Standards, PS1-74, classifies yellow-poplar as a Group 2 wood. Being a Group 2 wood places some limitations upon its uses as a veneer for the construction of sheathing panels. The limitations of the standards are stated as follows:

> C-C Exterior, C-D, and Structural panels of Group 2 may be marked with the same Identification Index as Group 1 woods, (southern pines are Group 1 woods), if the 5/16, 3/8, 1/2, 5/8, and 3/4 inch thick panels are manufactured 1/32 inch thicker than the standard nominal thickness, and the 5/8 inch and 3/4 inch panels have 1/8 inch minimum thick faces and backs, or if the 1/2, 5/8, and 3/4 inch panels are manufactured to the standard nominal thickness and have outer layers of Group 2 woods of 1/6 inch minimum thickness (21).

Hence, Group 2 woods, by meeting specified exceptions, may be used for the recommended maximum spans in inches under normal use conditions of roof framing and floor framing. These exceptions are that 5/16, 3/8, 1/2, 5/8, and 3/4 inch panels be 1/32 inch thicker. Therefore, the panels would be 11/32, 13/32, 17/32, 21/32, and 25/32 inch thick, respectively, and the 21/32 inch and 25/32 inch panels

TABLE 1

Log and Wood Characteristics and Features of Yellow-poplar

General Characteristics for Wood	Characteristics of Yellow-Poplar
Width of Sapwood	2 inches to 6 inches
Eccentricity	Little, very suitable for veneer
Crook (Sweep)	Not common in yellow-poplar
Taper	Small amount of taper
End Splits	Not common in yellow-poplar
Shake	Not common in yellow-poplar
Decay	Intermediate in decay resistance
Knots	Very suitable for veneer
Seams	Infrequent
Reaction Wood	Insignificant
Resin or Gum	None
Insect Attack	Fairly resistant to insect attack
Bird Peck	Not common in yellow-poplar
Bark Pockets	Not common in yellow-poplar
Wet Wood	Not common in yellow-poplar
Stain	Common in yellow-poplar
Hard Deposits	Not common in yellow-poplar
Bark	Easily removed
Specific Gravity	.40
Green Moisture Content	Sapwood 110%; Heartwood 80%
Permeability	Sapwood, permeable; heartwood, refractory
Shrinkage Green to Overdry	Tangential 8.2%; Radial 4.6%; Volumetric 12.3%
Vessels (Pores)	Arrangement, diffuse-porous; size, small, medium textured
Grain	Straight

TABLE 1 (Continued)

General Characteristics for Wood	Characteristics of Yellow-Poplar
Color	Sapwood, white; Heartwood, light yellow-green, occasional dark green or purple streaks
Tension Perpendicular to Grain	510 p.s.i.
Hardness (Side)	540 pounds
Modulas of Elasticity	1,580,000 p.s.i.
Modulas of Rupture	10,100 p.s.i.
Compression Parallel to the Grain Maximum Crushing Strength	5,540 p.s.i.
Compression Perpendicular to the Grain Fiber Stress at Proportional Limit	500 p.s.i.
Shear Parallel to Grain Maximum Shearing Strength	1,190 p.s.i.
Suggested Conditioning Temperature	70° to 120° F.
Aggravation of Log Splitting due to Heating	Not common in yellow-poplar
Sensitivity to Setting of Knife	Not extremely critical in yellow-poplar
Sensitivity to Setting of Pressure Bar	Not extremely critical in yellow-poplar
Drying Time	Sapwood, intermediate; Heartwood, intermediate
Defects in Drying	
Buckle	Not common in yellow-poplar
Splits	Not common in yellow-poplar
Collapse	Not common in yellow-poplar
Sap Stains	Susceptible
Mold	Susceptible

TABLE 1 (Continued)

General Characteristics for Wood	Characteristics of Yellow-Poplar
Iron Stain	Resists development
Oxidative Stain	Intermediate in resistance
Bacteria	
Odor	Susceptible
Extreme Permeability	Intermediate in resistance
Surface Irregularities	
Fuzzy	Intermediate in occurrence
Shelling	Resists development
Rough	Resists development
Clear Veneer	High percentage
Figure of Veneer	Faint growth ring

Source: John F. Lutz, Veneer Species that Grow in the United States. USDA, Forest Service, Forest Products Laboratory, Madison, Wisconsin, Research paper, FPL 167, 1972.

must have a 1/8 inch thick face and back ply. Another way to use Group 2 woods for 1/2, 5/8, and 3/4 inch panels is to make the outer layers 1/6 inch thick. This involves peeling all veneer to 1/6 inch to lay up 1/2 inch plywood. The 5/8 inch plywood could be 4 ply with the two inner plys 1/8 inch thick veneer. The 3/4 inch panel could be 5 ply, three layers with the middle layer made up of two 1/6 inch plys and a 1/8 inch ply.

The above is important because approximately 50% of all the plywood sold by the softwood plywood industry in 1976 was a C-D exterior glue panel (5), and yellow-poplar veneers may be used to construct this panel (21).

V. NEW AND SPECIALTY PRODUCTS

Yellow-poplar veneer has other plywood uses, one of which is a recently introduced product named Sturd-I-Floor. This new panel is intended to be used as a combination subflooring and underlayment. Sturd-I-Floor face and back veneer requirements for joist spacing are given in Table 2. This new product allows more versatility to the plywood producer using yellow-poplar veneer.

Other markets for panels in furniture construction, food and tobacco storage are in existence. These markets are being supplied mainly by the hardwood plywood industry.

Thus, potential markets for construction plywood products which can be made from yellow-poplar veneer do exist, and the PS1-74 specification allows its use. Another consideration is the successful performance of this species in the production process.

TABLE 2

Sturd-I-Floor Face and Back Veneer Requirements for Joist Spacing

Joist Spacing Index	Nominal Panel Thickness	Minimum Number Layers	Minimum Face and Back Veneer Thickness before Sanding for Species Group (inches) 1	2	3	4	Inner Ply Species Group
16	19/32		1/10	1/10	1/10	1/6	
	5/8		1/10	1/10	1/10	1/10	
20	19/32		1/10	1/6	NA	NA	
	5/8		1/10	1/8	1/6	NA	
	23/32		1/10	1/10	1/10	1/8	
	3/4		1/10	1/10	1/10	1/10	
24	23/32		1/10	1/6	3/16	NA	
	3/4		1/10	1/8	1/6	1/10	
	7/8		1/10	1/10	1/10	1/8	
48	1-1/8	5	1/8	1/6	NA	NA	1 or 2
	1-1/8	5	1/7	1/6	NA	NA	1, 2 or 3
	1-1/8	7	1/10	1/6	3/16	NA	1
	1-1/8	7	1/8	1/6	3/16	NA	1, 2 or 3

Source: American Plywood Association Manufacturing and Performance Specifications for Sturd-I-Floor Panels, effective January 15, 1978, Tacoma, Washington 98401.

VI. EQUIPMENT AND PROCEDURES

Today's high-speed automated chucking and lathe operations handle yellow-poplar quite well. Yellow-poplar bark is removed easily. The logs require little preconditioning, as the optimum temperature range is from 70°F. to 120°F. (14).

Through personal visits and communication with several southern pine plywood plants, considerable information was obtained as to the equipment and procedures used to peel yellow-poplar.[2,3,4]

The Boise Cascade Company in Moncure, North Carolina used some yellow-poplar veneer in their plywood production. They were experiencing some spin out and burst out problems. These problems were also experienced by the Georgia-Pacific's Monticello, Georgia plant when they experimentally peeled yellow-poplar for the Forest Services Laboratory in Athens, Georgia. In both cases the yellow-poplar was treated exactly as was southern yellow pine. The yellow-poplar logs were preconditioned to a temperature range which allowed optimum peeling of pines, 120°F. to 160°F. (14). Yellow-poplar logs conditioned

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[2]Personal visits and communication with Bill Gentry, Plant Manager, Boise Cascade Company, Moncure, North Carolina, January, February, and March 1978.

[3]Personal visit and communication with Terry Christianson, Georgia-Pacific Company, Monticello, Georgia, October 1977.

[4]Personal communication with Dave Carter, Union Camp Corporation, Chapman, Alabama, January 1978.

beyond the optimum of 120°F. (14) become too elastic, causing the chuck to spin out of the center of the log being peeled (14)[5,6]

Lutz and Patzer (13) found that optimum roller-bar openings for cutting yellow-poplar were smaller than those for cutting southern pine. The study also indicated that at all experimental roller-bar settings, yellow-poplar was considerably smoother than the southern pine veneer. They also found yellow-poplar tested superior to southern pine in strength and tension perpendicular to the grain.

Veneer drying time for yellow-poplar was listed as intermediate by Lutz or identical with yellow pines (14). However, experience at the Boise Cascade plant in Moncure indicated yellow-poplar took approximately 10% longer to dry than pine.

Yellow-poplar is uniform in density, peels smooth, and has no resin content (14). Less gluing problems exist with yellow-poplar than with southern pine (14). The gluing process used for southern pine seems to have no negative effect on yellow-poplar veneer, according to Bill Gentry, Terry Christianson, and Dave Carter.

VII. YIELD DATA

In a United States Forest Service experiment, yellow-poplar logs cut from the Oconee National Forest in the Georgia Piedmont were

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[5]Personal visits and communication with Bill Gentry, Plant Manager, Boise Cascade Company, Moncure, North Carolina, January, February, and March 1978.

[6]Personal visit and communication with Terry Christianson, Georgia-Pacific Company, Monticello, Georgia, October 1977.

peeled at the Georgia-Pacific Company's Monticello plant. These logs yielded a veneer recovery ratio (veneer cubic volume grade D or better[7] over total stem volume) of 45% (4) No changes were made in equipment set up or procedures from southern pine to yellow-poplar. A veneer recovery of 45% is reasonable. Clark, a Forest Service researcher who observed the experiment felt that perhaps the veneer pullers accustomed to yellow pine might not have been as efficient at grading and pulling yellow-poplar. Gentry,[8] Boise Cascade plant manager at Moncure, felt that his plant's recovery rate was just less than 50% for yellow-poplar and should improve if the spin out and burst out problems were solved.

As a comparison of yield recovery, a study of four western species of softwood reported veneer recovery rates ranging from 46% to 58% (23).

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[7]Veneer grades are those established in PSI-74. There are five usable grades (N, A, B, C, D) of veneer. The grade of N is the highest classification and D is the lowest.

[8]Personal visits and communication with Bill Gentry, Plant Manager, Boise Cascade Company, Moncure, North Carolina, January, February, and March 1978.

CHAPTER III

TIMBER RESOURCE

I. FOREST SERVICE INFORMATION

According to a range map published by the Forest Service, yellow-poplar is most concentrated in the area of the southern Appalachian mountain region from western Virginia on the north, to north Georgia on the south (16). Yellow-poplar is also identified as one of the most abundant hardwood species of the South (16).

Boyce and McClure indicated that 43% of the total yellow-poplar was in the southern Appalachian mountain province and that 33% was in the Piedmont province (2). They also stated that the net volume of yellow-poplar growing stock increased from between 1953 and 1970. They related the increased availability of yellow-poplar timber to the rapid growth of trees naturally established after harvest, and to a decline in the demand for yellow-poplar since about 1950.

II. TVA INFORMATION

The TVA inventory data revealed that yellow-poplar growing stock volume increased 7.4% in the five years from 1970 to 1975 (9). This study covered the 125 county area of the Tennessee valley watershed. The total growing stock volume in 1975 for yellow-poplar was 2,255.7 million cubic feet for this area. This TVA inventory also showed that sawtimber volume for yellow-poplar increased by 45% in the same five

year period. In 1970 sawtimber was 3,376 million board feet while in 1975 the volume was 5,365 million board feet.

Both the TVA and Forest Service inventory data substantiate that high concentrations of yellow-poplar sawtimber and growing stock are found in the areas in and surrounding the southern Appalachian mountains; and that good usable volumes of yellow-poplar are available (2) (9) (16). These high concentrations, together with the decreased demand of yellow-poplar, substantiates the need for greater utilization of this resource. One such utilization could be as veneer in the southern pine plywood industry.

III. MANAGEMENT PRACTICES

The future remains bright for yellow-poplar to continue to increase its volume. Beck (1) has pointed out that with relatively inexpensive and easy management practices, yellow-poplar can be regenerated in great numbers. He also pointed out that yellow-poplar was relatively intolerant of shade and thus reached its best development in even-aged stands. He stated that mature yellow-poplar trees can produce thousands of seeds per year, but just a small portion are viable--only about 5%. These seeds have the ability to remain viable in the duff for several years. Olson and Jarrett confirmed that the seeds can survive for at least eight years in this condition (17).

McGee and Clark indicated that when fully stocked stands of yellow-poplar exist, they produce and disperse ample seed to regenerate the stand (15). They pointed out, though, that mixed stands containing

scattered yellow-poplar represents the best opportunity to increase the abundance of yellow-poplar. Engle established that a mature yellow-poplar tree disperses seeds up to 350 feet in the direction of the prevailing wind (8). McGee and Clark further stated that logging is normally the only site preparation needed to provide enough new yellow-poplar seedlings for a new stand (15).

McGee and Clark pointed out that, economically, clearcutting provided the best method of harvesting to insure yellow-poplar regeneration (15). They also state that since aesthetics and forest uses other than timber production frequently have to be considered, clearcutting often cannot be carried out. Several other ways of harvesting were also reviewed by McGee and Clark. Selection, shelterwood, and seed tree methods do not afford the ideal conditions for regeneration furnished by a clearcut harvest (15). The alternative is to clearcut openings which satisfy the conditions for an economical harvest and proper regeneration, while being aesthetically gratifying and allowing other uses of the forest (15). The site preparation that must be met is scarification, which is usually satisfied in logging, provided that undesirable stems are eliminated after logging (15).

When these management tools are employed, successful restocking with yellow-poplar can be accomplished (15). The simplicity and ease of yellow-poplar regeneration enhances the outlook of a steady increase in yellow-poplar inventories for the future (2).

IV. AREAS OF CONCENTRATION

Based upon the TVA and Forest Service data, two areas with concentration of yellow-poplar sawtimber volume were selected as potential veneer plant sites. A city approximately in the geographic center of each area was selected to serve as a means to identify, analyze and compare the data collected. The two cities selected were Asheville, North Carolina and Bristol, Tennessee.

Using a 50 mile radius, a circle was drawn around these two cities to represent the hypothetical economic hauling distance from which logs could be purchased.[9] Tables 3, 4, 5 and 6 show the volumes within the radius distance from Asheville and Bristol. The Asheville area has 2,500.5 million board feet of yellow-poplar sawtimber and 3,244.1 million board feet of yellow pine sawtimber. Growing stock for the Asheville area is 822.1 million cubic feet of yellow-poplar and 1,128.5 million cubic feet of yellow pine (9).

The Bristol area has 2,796.4 million board feet of yellow-poplar sawtimber and 1,897.1 million board feet of yellow pine sawtimber. Yellow-poplar growing stock is 994.4 million cubic feet and yellow pine growing stock is 615.5 million cubic feet in the Bristol area (9).

Periodic annual increment (net change) in sawtimber was 384.3 million board feet of hardwood and 119.2 million board feet of

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[9]A 50 mile radius was decided upon after consultation with Bill Ogden, Forest Products Specialist, TVA, Drs. Harold Core and G. R. Wells, Forestry professors, The University of Tennessee.

TABLE 3

Sawtimber Volume in Millions of Board Feet (Doyle) for the Asheville, North Carolina Area

County and State	CFL[a] in Acres	Volume/Acres CFL YP[b]	Volume/Acres CFL SYP[c]	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[b]	Volume SYP[c]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Avery, NC	122.4	.51	.05	349.1	27.0	376.1	61.8	5.8	8.6	-3.0	11.6
Buncombe, NC	276.4	.78	.36	1108.0	132.8	1240.8	215.0	99.3	22.5	3.0	19.5
Burke, NC	257.3	.20	.99	374.2	480.4	854.6	51.6	255.1	1.3	6.5	-5.2
Caldwell, NC	252.2	.41	.68	628.0	520.8	1148.8	104.2	170.8	29.2	7.8	21.4
Cleveland, NC	131.3	.35	1.03	203.2	141.5	344.7	46.1	135.8	16.1	8.2	7.9
Haywood, NC	187.5	.66	.13	1022.4	159.4	1181.8	123.7	23.8	42.7	6.1	36.6
Henderson, NC	156.0	.75	.64	644.9	235.7	880.6	117.4	99.2	24.2	2.8	21.4
Jackson, NC	275.3	.36	.13	1123.5	244.9	1368.4	100.0	35.0	28.8	5.9	22.2
Macon, NC	265.9	1.00	.16	1526.8	174.7	1701.5	265.7	41.8	27.6	-.7	28.3
Madison, NC	213.6	.69	.77	901.7	361.6	1263.3	147.9	165.3	52.3	17.3	35.0
McDowell, NC	223.4	.61	.77	810.3	254.0	1064.3	136.9	172.2	36.0	10.3	25.7
Mitchell, NC	107.7	1.23	.03	612.2	81.5	693.7	132.2	3.5	30.2	3.7	26.5

TABLE 3 (Continued)

County and State	CFL[a] in Acres	Volume/Acres CFL YP[b]	Volume/Acres CFL SYP[c]	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[b]	Volume SYP[c]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Polk, NC	111.7	.52	.93	263.8	116.2	380.0	58.0	104.1	15.8	5.0	10.8
Rutherford, NC	253.0	.26	1.36	439.5	353.6	793.1	64.6	344.4	26.2	15.2	11.0
Swain, NC	109.1	.23	.91	335.8	104.4	440.2	24.8	99.6	13.2	3.0	10.2
Transylvania, NC	199.8	.74	.22	740.1	100.0	840.1	147.3	43.6	22.6	2.2	20.4
Yancey, NC	146.6	1.27	.02	864.6	245.7	1110.3	186.8	2.9	27.2	6.5	20.7
Cherokee, SC	123.9	.12	.52	110.7	65.5	176.2	15.3	64.5	1.2	.1	1.1
Greeneville, SC	265.8	.20	.44	421.2	118.0	539.2	52.7	115.9	1.7	-.3	2.0
Oconee, SC	385.4	.08	.57	356.0	268.3	624.3	31.7	220.5	-2.6	-7.2	4.6
Pickens, SC	284.4	.38	1.32	471.9	350.7	822.6	95.3	327.6	20.2	9.4	10.8
Spartanburg, SC	336.6	.12	.43	174.1	144.8	318.9	40.0	144.1	3.5	-.4	3.9
Carter, TN	150.3	.69	.41	427.4	196.1	623.9	104.3	61.6	15.0	3.9	11.1

TABLE 3 (Continued)

County and State	CFL[a] in Acres	Volume/Acres CFL YP[b]	Volume/Acres CFL SYP[c]	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[b]	Volume SYP[c]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Cocke, TN	182.6	.12	.48	581.7	227.4	809.1	22.1	88.2	14.1	.8	13.3
Greene, TN	132.5	.35	.42	378.5	111.2	489.7	46.6	55.7	10.0	3.0	7.0
Jefferson, TN	59.7	.07	1.45	125.9	86.3	212.2	4.3	86.3	-1.3	.3	-1.6
Sevier, TN	159.2	.19	.90	415.1	209.7	624.8	30.7	143.0	10.8	5.0	5.8
Unicoi, TN	99.8	.30	.72	234.1	160.4	394.5	29.5	71.7	3.6	2.9	.7
Washington, TN	65.3	.67	.96	158.7	74.0	232.7	44.0	62.8	3.5	1.9	1.6
TOTAL	5498.4			15803.4	5746.6	21550.0	2500.5	3244.1	503.5	119.2	384.3

[a]CFL = Commercial Forest Land.

[b]YP = Yellow-poplar.

[c]SYP = Southern yellow pine.

Source: USDA, Forest Service and TVA inventory data.

TABLE 4

Growing Stock Volume in Millions of Cubic Feet for the Asheville, North Carolina Area

County and State	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[a]	Volume SYP[b]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Avery, NC	130.5	7.7	138.2	14.2	1.6	.2	-.5	.7
Buncombe, NC	352.7	43.1	395.8	63.4	32.2	6.3	.4	5.9
Burke, NC	158.6	157.9	316.5	23.3	83.8	.4	.9	-.5
Caldwell, NC	267.2	125.7	392.5	40.6	41.2	8.5	1.1	7.4
Cleveland, NC	68.0	67.2	135.2	15.4	66.2	3.3	2.0	1.3
Haywood, NC	324.3	49.6	373.9	32.3	7.4	10.9	.8	10.3
Henderson, NC	212.3	67.6	279.9	36.6	28.5	7.1	1.2	5.9
Jackson, NC	295.8	53.0	348.8	30.2	7.6	8.2	1.5	6.7
Macon, NC	397.5	32.6	430.1	60.1	7.8	8.3	.0	8.3
Madison, NC	314.5	102.8	417.3	48.1	47.0	13.4	3.8	9.6
McDowell, NC	287.6	72.5	360.1	40.3	54.6	9.0	1.7	7.3
Mitchell, NC	220.8	21.0	241.8	54.3	.9	8.2	.9	7.3

TABLE 4 (Continued)

County and State	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[a]	Volume SYP[b]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Polk, NC	88.9	48.2	137.1	18.0	46.1	5.0	2.2	2.8
Rutherford, NC	179.9	141.0	320.9	19.6	137.3	6.9	1.9	5.0
Swain, NC	108.9	21.8	130.7	11.4	20.8	3.7	.5	3.2
Transylvania, NC	261.3	33.1	294.4	51.0	14.4	7.1	1.0	6.1
Yancey, NC	269.5	54.4	323.9	51.5	.7	6.8	1.5	5.3
Cherokee, SC	75.2	41.7	116.9	7.2	41.0	2.1	.3	1.8
Greenville, SC	223.4	89.4	312.8	29.5	87.8	6.3	2.2	4.1
Oconee, SC	175.9	119.9	295.8	16.2	98.6	2.0	-.5	2.5
Pickens, SC	180.4	116.6	292.0	30.8	10.8	4.9	2.3	2.6
Spartanburg, SC	102.1	128.1	230.2	14.1	127.5	5.3	3.0	2.3
Carter, TN	206.7	47.1	253.8	32.8	14.8	6.1	.6	5.5
Cocke, TN	201.6	54.5	256.1	14.3	21.1	6.1	.4	5.7
Greene, TN	114.3	35.9	150.2	13.5	18.0	3.7	1.1	2.6
Jefferson, TN	26.4	31.5	57.9	1.2	31.5	.2	.3	-.5

TABLE 4 (Continued)

County and State	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[a]	Volume SYP[b]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Sevier, TN	129.5	72.7	202.2	11.4	49.6	6.2	2.4	3.8
Unicoi, TN	103.9	27.5	131.4	23.9	12.3	2.1	.3	1.8
Washington, TN	58.2	20.5	78.7	16.9	17.4	1.9	.6	1.3
TOTAL	5535.9	1879.6	7415.5	822.1	1128.5	159.8	33.9	125.9

[a]YP = Yellow-poplar.

[b]SYP = Southern yellow pine.

Source: USDA, Forest Service and TVA inventory data.

TABLE 5

Sawtimber Volume in Millions of Board Feet (Doyle) in the Bristol, Tennessee Area

County and State	CFL[a] in Acres	Volume/Acres CFL YP[b]	Volume/Acres CFL SYP[c]	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[b]	Volume SYP[c]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Harlan, KY	271.4	.31		766.5	30.1	796.6	87.4		12.4	.5	11.9
Letcher, Ky	197.7	.32		532.2	24.5	556.7	61.2		8.7	.4	8.3
Alleghany, NC	73.1	.33		251.8	12.3	264.1	24.2		4.6	.8	3.8
Ashe, NC	156.1	.15	.03	475.7	41.4	517.1	22.8	4.0	5.2	.5	4.7
Avery, NC	122.4	.51	.05	349.1	27.0	376.1	61.8	5.8	8.6	-3.0	11.6
Burke, NC	257.3	.20	.99	374.2	480.4	854.6	51.6	255.1	1.3	6.5	-5.2
Caldwell, NC	252.2	.41	.68	628.0	520.8	1148.8	104.2	170.8	29.2	7.8	21.4
Madison, NC	213.6	.69	.77	901.7	361.6	1263.3	147.9	165.3	52.3	17.3	35.0
McDowell, NC	223.4	.61	.77	810.3	254.0	1064.3	136.9	172.2	36.0	10.3	25.7
Mitchell, NC	107.7	1.23	.03	612.2	81.5	693.7	132.2	3.5	30.2	3.7	26.5
Watauga, NC	132.0	.81		488.2	84.2	572.4	107.4		24.5	3.7	20.8
Wilkes, NC	372.5	.67	1.22	866.5	728.9	1595.4	247.8	452.6	54.5	19.2	35.3

TABLE 5 (Continued)

County and State	CFL[a] in Acres	Volume/Acres CFL YP[b]	Volume/Acres CFL SYP[c]	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[b]	Volume SYP[c]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Yancey, NC	146.6	1.27	.02	864.6	245.7	1110.3	186.8	2.9	27.2	6.5	20.7
Carter, TN	150.3	.69	.41	427.4	196.1	623.5	104.3	61.6	15.0	3.9	11.1
Greene, TN	132.5	.35	.42	378.5	111.2	489.7	46.6	55.7	10.0	3.0	7.0
Hancock, TN	98.1	.24	.16	254.0	16.0	270.0	23.9	16.0	14.0	.2	13.8
Hawkins, TN	170.0	.30	.72	375.0	123.7	489.7	50.6	122.2	11.7	4.2	7.5
Johnson, TN	134.7	.42	.46	342.1	347.3	689.4	57.1	62.2	6.6	-.7	7.3
Sullivan, TN	131.6	.33	.29	373.6	138.5	512.1	43.0	37.7	2.3	3.3	-1.0
Unicoi, TN	99.8	.30	.72	234.1	160.4	394.5	29.5	71.7	3.6	2.9	.7
Washington, TN	65.3	.67	.96	158.7	74.0	232.7	44.0	62.8	3.5	1.9	1.6
Buchanan, VA	212.1	.38		771.1	59.9	831.0	81.0	.9	6.9	1.4	5.5
Dickenson, VA	165.2	.57	.07	506.6	24.6	531.2	93.7	12.2	-5.0	1.3	-6.3
Grayson, VA	124.2	.10	.04	186.2	136.4	322.6	12.1	5.2	-1.4	.2	-1.6
Lee, VA	154.0	1.10	.06	552.7	40.8	593.5	169.7	8.8	12.8	.5	12.3

TABLE 5 (Continued)

County and State	CFA[a] in Acres	Volume/Acres CFL YP[b]	Volume/Acres CFL SYP[c]	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[b]	Volume SYP[c]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Russell, VA	168.1	.89		632.1	1.5	633.6	150.4		22.1		22.1
Scott, VA	219.6	.64	.10	775.0	25.0	800.0	139.5	21.7	8.3	.8	7.5
Smyth, VA	127.7	.85	.30	466.8	51.0	517.8	108.1	38.6	11.2	2.5	8.7
Tazewell, VA	213.3	.38	.24	562.1	63.8	625.9	80.9	51.7	18.8	.1	18.2
Washington, VA	201.0	.12	.16	401.9	63.0	464.9	24.1	31.5	15.9	1.7	14.2
Wise, VA	215.0	.77	.02	753.2	88.0	842.0	165.7	4.4	8.6	.6	8.0
TOTAL	5308.5			16072.1	4614.4	20686.5	2796.4	1897.1	459.6	102.5	357.1

[a]CFL = Commercial forest land.

[b]YP = Yellow poplar.

[c]SYP = Southern yellow pine.

Source: USDA, Forest Service and TVA inventory data.

TABLE 6

Growing Stock Volume in Millions of Cubic Feet for the Bristol, Tennessee Area

County and State	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[a]	Volume SYP[b]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Harlan, KY	275.4	12.0	287.4	41.6		4.8	.2	4.6
Letcher, KY	193.3	9.8	203.1	30.0		3.4	.2	3.2
Alleghany, NC	85.0	3.7	89.4	8.9		1.9	.2	1.7
Ashe, NC	168.9	12.4	181.3	7.4	3.3	2.9	.3	2.6
Avery, NC	130.5	7.7	138.2	14.2	1.6	.2	-.5	.7
Burke, NC	158.6	157.9	316.5	23.3	106.9	.4	.9	-.5
Caldwell, NC	267.2	125.7	392.9	40.6	47.0	8.5	1.1	7.4
Madison, NC	314.5	102.8	417.3	48.1	47.0	13.4	3.8	9.6
McDowell, NC	287.6	72.5	360.1	40.3	49.2	9.0	1.7	7.3
Mitchell, NC	220.8	21.0	241.8	54.3	.9	8.2	.9	7.3
Watauga, NC	197.4	19.8	217.2	43.4		5.8	.7	5.1
Wilkes, NC	356.4	260.5	616.9	98.0	161.8	18.3	7.1	11.2

TABLE 6 (Continued)

County and State	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[a]	Volume SYP[b]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Yancey, NC	269.5	54.4	323.9	51.5	.7	6.8	1.5	5.3
Carter, TN	206.7	47.1	253.8	32.8	14.8	6.1	.6	5.5
Greene, TN	114.3	35.9	150.2	13.5	18.0	3.7	1.1	2.6
Hancock, TN	81.4	6.9	88.3	12.8	6.9	1.7	.1	1.6
Hawkins, TN	157.6	43.6	201.2	14.9	43.1	6.3	1.5	4.8
Johnson, TN	172.8	77.8	250.6	10.2	13.9	4.5	.3	4.2
Sullivan, TN	117.8	32.5	150.3	10.5	8.8	2.0	.9	1.1
Unicoi, TN	92.8	36.6	129.4	14.4	16.4	2.6	.6	2.0
Washington, TN	58.2	20.5	78.7	16.9	17.4	1.9	.6	1.3
Buchanan, VA	291.3	15.1	306.4	38.7	.2	3.8	.4	3.4
Dickenson, VA	220.4	5.6	226.0	44.1	2.8	-.5	.1	-.6
Grayson, VA	102.6	37.6	140.2	7.7	1.4	.5	.1	.4
Lee, VA	195.0	12.9	207.9	51.6	2.8	4.7	.3	4.4
Russell, VA	219.9	1.0	220.9	36.1		6.3		6.3

TABLE 6 (Continued)

County and State	Hardwood Volume	Softwood Volume	Total Volume	Volume YP[a]	Volume SYP[b]	Annual Net Change Total	Annual Net Change Softwood	Annual Net Change Hardwood
Scott, VA	307.2	17.2	324.4	44.8	14.9	2.7	.7	2.0
Smyth, VA	210.7	17.1	227.8	31.9	12.9	4.6	.9	3.7
Tazewell, VA	262.6	15.2	277.8	35.9	12.2	8.8	.2	8.6
Washington, VA	192.2	19.4	211.6	17.3	9.7	6.2	.6	5.6
Wise, VA	290.8	18.9	309.7	58.7	.9	-.4	.2	-.6
TOTAL	6220.1	1321.1	7541.2	994.4	615.5	149.1	27.3	121.8

[a]YP = Yellow-poplar.

[b]SYP = Southern yellow pine.

Source: USDA, Forest Service and TVA inventory data.

softwood for the Asheville area. For the Bristol area the average net change in sawtimber was 357.1 million board feet of hardwood and 102.5 million board feet for softwood (9).

In the Asheville area yellow-poplar totaled about 15.8% of the hardwood sawtimber volume and yellow pine was 56.4% of the softwood sawtimber volume. In the Bristol area 17.4% of the hardwood sawtimber was yellow-poplar and 41.1% of the softwood sawtimber was yellow pine (9). Assuming that the composition of net annual change is proportional to the sawtimber volume, the net annual change of yellow-poplar and yellow pine is 127.9 million board feet for Asheville and 104.2 million board feet for Bristol. And assuming that 40% of the net annual change would be available for harvest, this would mean 51.2 million board feet of yellow-poplar and yellow pine sawtimber could be used annually by a plywood manufacturer in the Asheville area (12). In the Bristol area 41.7 million board feet would be available.

V. OWNERSHIP CHARACTERISTICS

The ownership characteristics of the commercial forest land in the Asheville and Bristol areas for each county involved may be found in Tables 7 and 8. A summary of this data is found in Table 9. Ownership patterns of the commercial forest land were similar for both the Asheville area and the Bristol area with private, nonindustrial owners predominant (9).

TABLE 7

Commercial Forest Land in Acres for the Asheville, North Carolina Area

County and State	All Ownership	National Forest	Other Public	Forest Industry	Farmer	Miscellaneous Private
Avery, NC	122,244	22,558	435	2,344	26,430	70,477
Buncombe, NC						
Burke, NC	251,090	38,354	9,657	14,109	43,135	146,654
Caldwell, NC	244,711	49,228	1,058	22,349	27,532	144,544
Cleveland, NC	130,302		639	1,672	83,826	44,165
Haywood, NC						
Henderson, NC						
Jackson, NC	281,200	26,669	18,960	11,819	71,919	151,833
Macon, NC	279,160	135,646	27	522	81,693	61,272
Madison, NC	214,265	47,185	1,469	363	151,478	13,771
McDowell, NC	225,505	65,686	920	13,625	36,319	108,955
Mitchell, NC	103,674	15,053	2,849	531	45,899	39,342
Polk, NC	111,541		4,465	13,010	22,375	71,691

TABLE 7 (Continued)

County and State	All Ownership	National Forest	Other Public	Forest Industry	Farmer	Miscellaneous Private
Rutherford, NC	253,859		522	22,792	72,171	158,374
Swain, NC	117,420	13,349	29,450		20,351	54,270
Transylvania, NC						
Yancey, NC	141,120	24,054	62	2,325	79,395	35,284
Cherokee, SC	154,802		88	11,668	91,767	51,279
Greeneville, SC	278,448		2,580	6,895	136,655	132,318
Oconee, SC	280,294	74,125	10,498	919	63,407	131,345
Pickens, SC	209,464		10,638	1,638	43,710	153,428
Spartanburg, SC	271,227		8,196	19,543	119,543	124,447
Carter, TN	157,886	78,900			27,848	51,502
Cocke, TN	168,000	42,200	100		72,300	53,400
Greene, TN	135,200	35,700	100		92,900	6,500
Jefferson, TN	58,500		900		49,100	8,500

TABLE 7 (Continued)

County and State	All Ownership	National Forest	Other Public	Forest Industry	Farmer	Miscellaneous Private
Sevier, TN	159,200		800		70,900	87,500
Unicoi, TN	94,400	51,500	100	11,800		31,000
Washington, TN	61,600	16,500			33,400	11,700
TOTAL	4,505,931	736,707	104,563	157,924	1,563,187	1,943,551
AVERAGE	180,237	29,468	4,183	6,317	62,527	77,742

Source: USDA, Forest Service and TVA inventory data.

TABLE 8

Commercial Forest Land in Acres for the Bristol, Tennessee Area

County and State	All Ownership	National Forest	Other Public	Forest Industry	Farmer	Miscellaneous Private
Harlan, KY	268,200	420	5,026			
Letcher, KY	194,500	480	6,000			
Alleghany, NC	71,030		6		39,458	31,366
Ashe, NC	154,140		82		102,705	51,353
Avery, NC	122,244	22,558	435	2,344	26,430	70,477
Burke, NC	251,909	38,354	9,657	14,109	43,135	146,654
Caldwell, NC	244,711	49,228	1,058	22,349	27,532	144,544
Madison, NC	214,265	47,185	1,464	363	151,478	13,770
McDowell, NC	225,505	65,686	920	13,625	36,319	108,955
Mitchell, NC	103,674	15,053	2,849	531	45,899	39,342
Watauga, NC	131,638	393	215	10,602	34,409	86,019
Wilkes, NC	370,646		8,526	27,546	86,957	247,617
Yancey, NC	141,120	24,054	62	2,325	79,395	35,284

TABLE 8 (Continued)

County and State	All Ownership	National Forest	Other Public	Forest Industry	Farmer	Miscellaneous Private
Carter, NC	157,886	78,900			27,484	51,502
Greene, NC	135,200	35,700	100		92,900	6,500
Hancock, NC	99,110				98,414	696
Hawkins, NC	167,400		6,400	5,400	118,000	37,600
Johnson, TN	140,674	49,000	100		29,263	52,311
Sullivan, TN	109,200	36,900	2,900		29,200	40,200
Unicoi, TN	94,400	51,500	100	11,800		31,000
Washington, TN	61,600	16,500			33,400	11,700
Buchanan, VA	271,192			23,310	44,800	204,081
Dickenson, VA	176,529	8,768	5,719		27,939	134,103
Grayson, VA	155,892	15,581		1,819	110,792	27,700
Lee, VA	159,989	11,370		279	37,085	111,255
Russell, VA	159,563		5,396	130	64,596	89,441
Scott, VA	230,360	25,268	200	381	119,297	85,214

TABLE 8 (Continued)

County and State	All Ownership	National Forest	Other Public	Forest Industry	Farmer	Miscellaneous Private
Smyth, VA	173,650	65,928	8,912		57,206	41,604
Tazewell, VA	204,713	5,742	4,171	2,250	71,520	121,030
Washington, VA	189,973	18,284	7,710		54,661	109,318
Wise, VA	210,513	37,576	7,793		27,542	137,620
TOTAL	4,928,726	719,528	74,780	138,163	1,727,798	2,268,457
AVERAGE	169,956	24,811	2,579	4,764	59,579	78,230

Source: USDA, Forest Service and TVA inventory data.

TABLE 9

Percentage of Ownership of Commercial Forest Land
for the Asheville, North Carolina and
Bristol, Tennessee Areas

Area	National Forest	Other Public	Forest Industry	Farmer	Miscellaneous Private
Asheville, NC	16.4%	2.3%	3.5%	34.7%	43.1%
Bristol, TN	14.6%	1.5%	2.8%	35.0%	46.1%

Source: USDA, Forest Service and TVA inventory data.

VI. WILLINGNESS TO SELL

A survey was taken in 1977 of private, nonindustrial land owners in a six county area of southeastern Tennessee. Estimates of availability averaged only 15.4% of those interviewed, or as being "willing to sell" timber from their land, and 26% indicated that they might be "willing to sell" (22). Although the ability to determine the intention of people to sell timber has many variables which are difficult to measure, this study and others of similar nature give an idea of what might be expected from private timber tracts in any one year.

Around 15% of the commercial forest land of both these areas is owned by the Forest Service (9). The national forests involved are the Cherokee in east Tennessee, the Daniel Boone in southeast Kentucky, Nantahala in north Georgia, Pisgah in western North Carolina, and the Jefferson in southwestern Virginia. The programmed harvest for fiscal year 1978 for both hardwoods and softwoods may be found for each national forest in Table 10. According to the Forest Service the cuts will remain about the same in fiscal year 1979 and 1980.[10]

The commercial forest land owned by forest industries was only about 4% (9) and no information was obtained as to their expected harvest.

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[10]Personal communication with Carl Stoneking, USDA, Forest Service, Atlanta, Georgia, January 1978.

TABLE 10

Programmed Harvest (Current Cutting Practice) for Fiscal 1978, October 1977 to September 1978 by National Forest

Forest	Sawtimber	
	Softwood	Hardwood
Cherokee National	16.0 millions of board feet	8.5 millions of board feet
Daniel Boone National	7.7 millions of board feet	19.0 millions of board feet
Nantahala National	4.5 millions of board feet	8.56 millions of board feet
Pisgah National	0.5 millons of board feet	5.4 millions of board feet
Jefferson National	1.0 millions of board feet	5.6 millions of board feet

Note: The cuts for fiscal 1979 and 1980 appear that they will remain about the same.

Source: Information obtained by phone from Carl Stoneking, USDA, Forest Service, Atlanta, Georgia, January, 1978.

There are many forest products operations which are established and using timber from the counties around Asheville and Bristol. This includes 64 primary and 68 secondary forest products plants in the Asheville area and 48 primary and 59 secondary forest products plants in the Bristol area (6) (7).

Timber prices for the two areas being considered are given in Table 11. These prices are averages of second and third quarters of 1977 prices reported in Timber Mart South (20).

TABLE 11

Prices for Timber F.O.B. Second and Third Quarter 1977 Averages

Area	Yellow-Poplar*	Southern Pine**
Northern Georgia	$ 95	$ 157
Western North Carolina	109	155
Western South Carolina	96	154
Eastern Tennessee	110	N.A.
Western Virginia	88	154

*Yellow-poplar prices are dollars per thousand board feet Doyle for sawtimber logs.

**Southern pine prices are dollar per thousand board feet Scribner for peeler logs.

Source: Timber Mart South, P.O. Box 1278, Highland, North Carolina, 28741.

CHAPTER IV

COST ANALYSIS

In developing the cost analysis portion of this study, the various cost factors for a veneer plant were investigated.

I. COST ASSUMPTIONS

It was initially thought that a small investor might be interested in financing such an endeavor. It was found that an initial investment of approximately $1,900,000 would be needed for a modern veneer plant. It was felt that the size of investment would be prohibitive to a small investor. It was also found that for an additional investment of approximately $500,000 and a higher operating cost, a complete but small plywood plant could be established. However, the detailed portion of this study will deal only with the cost involved with a veneer plant.

II. SIMULATION MODEL

In analyzing the cost information, a computer simulation entitled "A Cash Flow Analysis Computer Program for Analyzing Investment Opportunities in the Wood Products Manufacturing Process" was used (11). This program determines the present value of the investment, internal and composite rate of return, total unit costs of production--including taxes and profit--and the maximum investment that can be made to obtain a minimally attractive rate of return.

III. COST INPUTS

The results of the computer analysis are only as good as the information supplied to the computer and the understanding of that information. Thus the procedure for obtaining each of the inputs must be justified.

Selling expense was assumed to be 2% of gross sales to account for a 2% cash discount. Other selling expenses were not considered.

Working capital is the cost tied up in unsold goods-in-process, finished products inventories, and accounts receivable. A 30 day log supply, 10 days finished goods, and five days accounts receivable were considered for the study. This allows an 18% working capital ratio (30 days plus 10 days plus five days ÷ 250 working days per year = 18%).

A tax rate of 51.12% was used and was arrived at by considering a 48% federal income tax rate plus a 6% deductible state tax less 48% multiplied by 6% which equals 51.12%.

A discount rate of 18.5% was used to represent the rate of return expected from a similar project or dollar amount invested. This rate may also be compared to an alternative rate of return.

A ten year planning horizon for the financial analysis was assumed. All calculations and analyses were projected or discounted for a ten year period.

The original cash investment portion of the program was assumed to be 20% of the total investment. Twenty percent was considered to be an

an average amount of cash to be put into an investment of this size.[11]

A short term borrowing rate of 8.7% and a short term reinvestment rate of 10.5% was assumed in the simulation.

Unit price, the selling price per cubic foot of veneer, entered for this venture was $3.42 for the first year and was inflated by 6% for the other nine years considered. The 6% inflation rate was used to compute all of the cost figures for the projected nine years.

Unit price was figured by taking the average of the weekly prices listed in Crow's newsletter for the months of December 1977 and January 1978 (19). These prices were quoted for 1/6 inch fir veneer, grade C and D, 8 feet long and at least 30% of it 54 inches wide. The average was $47.50 per 1,000 square feet. There is 13.89 cubic feet in 1,000 square feet of 1/6 inch veneer. Thus, $47.50 divided by 13.89 cubic feet equals $3.42 per cubic feet.

Unit price, unit sales and unit manufacturing cost all had to be converted to the same unit of measurement. Cubic feet were chosen as the common unit of measure.

The Equipment Proposal shown in Appendix A will produce 221,130 square feet of 1/6 inch veneer per day.[12] This is equivalent to 3,071.25 cubic feet of veneer per day, and assuming 250 working days per year, amounts to 767,812.5 cubic feet per year.

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[11]Personal communication with Dr. William Goolsby, Finance Professor, The University of Tennessee, April 1978.

[12]Personal communication with Hank Serdio, Coe Manufacturing Company, Painesville, Ohio, February 28, 1978.

Unit sales of 767,812.5 cubic feet per year was used. In the first year it was assumed that the plant could operate only at 80% capacity (614,250 cubic feet of veneer) because of unfamiliarity with operation, maintenance and repair. The following nine years were considered at 100% capacity (767,812.5 cubic feet of veneer).

Unit manufacturing cost, cost of the log per cubic feet of veneer produced, was $1.34. There are 60.5 board feet Doyle scale per one 15-inch diameter by 8-feet in length log, giving a value of approximately $6.05 per log (20). The volume of this log would be approximately 9.8 cubic feet. Multiplying the veneer recovery ratio of 45%, as determined by Clark (4), by 9.8 cubic feet gives 4.42 cubic feet or 4.5 cubic feet expressed as a round number. Thus, $6.05 per log divided by 4.5 cubic feet per log equals $1.34 cost per cubic foot of veneer produced.

Labor, power, fuel and utilities costs were entered into the computer simulation as both variable and fixed manufacturing cost. The percentage breakdown between fixed and variable cost was arbitrary and was obtained by examining financial analysis of similar wood using industries. Unless plant size was varied by different simulation runs, the breakdown of cost between fixed and variable did not affect the final results, since output and variable costs were held constant.

Labor cost was estimated to be $447,660 per year, of which 20%, or $89,500, was considered as fixed. The variable labor costs were computed to be $358,160 per year. Table 12 gives a breakdown of the total labor cost.

TABLE 12

Labor Cost

Number of Employees	Job	Computation	Cost
1	Scaler-knife grinder and utility man	$5/hour x 2,000 hours	$10,000
1	Lathe operator	$5/hour x 2,000 hours	$10,000
1	Spotter	$4.50/hour x 2,000 hours	$ 9,000
1	Clipper	$5/hour x 2,000 hours	$10,000
4	Grader pullers	$4.50/hour x 2,000 hours x 4	$36,000
6	Feeders for dryer	$4.25/hour x three shifts x 2,000 hours x 2	$51,000
6	Pullers for dryer	$4.25/hour x three shifts x 2,000 hours x 2	$51,000
1	Dry clipper	$5/hour x 2,000 hours	$10,000
1	Patcher	$5/hour x 2,000 hours	$10,000
1	Tractor operator	$4.75/hour x 2,000 hours	$ 9,500
1	Debarker	$4.50/hour x 2,000 hours	$ 9,000
1	Log cut off saw operator	$4.50/hour x 2,000 hours	$ 9,000

TABLE 12 (Continued)

Number of Employees	Job	Computation	Cost
1	Core chipper operator	$4.50/hour x 2,000 hours	$ 9,000
4	Fork lift drivers	$4.75/hour x 2,000 hours x 4	$38,000
3	Boiler operators	$4.75/hour x 2,000 hours x 3	$28,500
1	Green end foreman		$13,000
3	Dry end foremen	$13,000 x 3	$39,000
2	Dock workers	$4.50/hour x 2,000 hours x 2	$18,000
4	Maintenance	$5/hour x 2,000 hours x 4	$40,000
1	Manager		$21,060
2	Administration	$4.15/hour x 2,000 hours x 2	$16,600
TOTAL LABOR COST			$447,660

Source: Wages, Salaries and Fringe Benefits Survey, Sullivan, Johnson and Eastern Hawkins Counties. The Department of Economic and Community Development, 1012 Andrew Jackson State Office Building, Nashville, Tennessee 37219.

Power rates were obtained from TVA and are for the Bristol, Tennessee area. The veneer plant would have a typical monthly bill of $4,133.42 or $49,601 for a year. The fixed power cost was considered 12.5% of the total, or $6,200 per year and variable cost would be $43,401 per year.

Fuel costs were not considered to be a variable or a fixed cost because of the use of a wood burning boiler. Also, the sale of cores, chips, and scraps was not considered as a source of income.

The cost of utilities was estimated at $1,224 per year, of which $720 was the cost of water and $504 was the sewage cost. The fixed portion of utilities was considered to be about 25% of the total or $300.

Overhead cost was determined to be $417,400 and included operating and maintenance supplies cost, property tax, and insurance cost. Operating and maintenance supply costs were figured at $2.22 per 1,000 square feet of 1/6 inch thick veneer (operating cost), and $3.11 1/3 per 1,000 square feet of 1/6 inch thick veneer (maintenance supply cost), or a total cost of $5.33 1/3 per 1,000 square feet of 1/6 inch thick veneer.[13] The total cost per year is calculated as follows:

$$\frac{\$5.33\ 1/3 \times 55{,}282{,}500 \text{ square feet per year}}{1{,}000 \text{ square feet}} = \$294{,}840.$$

The real property tax rate for Sullivan County, Tennessee was $3.18 per $100 of assessed value. Assessed value for real property was 40% of appraised value, and appraised value would be approximately 90%

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[13]Personal communication with Bob Ridgeway, American Plywood Association, Tacoma, Washington, April 1978.

of market value by practice. Thus land ($187,500), boiler ($350,000), and building ($120,750) equal a total market value of $658,250. This figure multiplied by 90% gives the appraised value of $592,452. This value is multiplied by 40% to give the assessed value of $236,980. The tax rate of $3.18 per $100 is applied to give a yearly tax cost of $7,535.65.

The insurance rates supplied by Walker[14] placed the total insurance cost at $115,025. This coverage included property, workman's compensation, general liability, and group medical coverage for the employees and their families.

Facilities cost figures were made up of five major costs. These include: 1) the cost of wood burning boiler, 2) building cost, 3) cost of equipment, 4) land cost, and 5) plant cost.

A divisional breakdown of the $1,950,392 facilities cost may be found in Table 13. Plant, equipment, and boiler cost information were provided by the Coe Manufacturing Company of Painesville, Ohio. The itemized proposal is found in Appendix A. Building cost information was provided by the Butler Metal Buildings office.[15]

The depreciation schedule may be found as Table 14. The depreciation method used was the double declining balance method.

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[14]Personal visit and communication with Jerry Walker, Commercial Insurance Agent, Tennessee Insurance Service, Knoxville, Tennessee, April 1978.

[15]Personal communication with the Butler Metal Buildings, Knoxville, Tennessee, April 1978.

TABLE 13

Facilities Cost

Item	Cost
Boiler (Wood burning)*	$350,000
Building** ($7.50 per square feet x 16,100 square feet)	$120,750
Equipment*	$224,070
Land (75 acres x $2,500 per acre)	$187,500
Plant*	$1,068,072
Total Facilities Cost	$1,950,392

*Personal communication with Hank Serdio, The Coe Manufacturing Company, Painesville, Ohio 44077, February 28, 1978.

**Personal communication with Butler Steel Buildings, Knoxville, Tennessee, February 1978.

TABLE 14

Depreciation Schedule

Year	Depreciation
1	$292,826.00
2	$234,260.80
3	$187,408.60
4	$149,926.90
5	$119,941.50
6	$ 95,953.20
7	$ 76,762.60
8	$ 61,410.10
9	$ 49,128.10
10	$ 39,302.40
Total Plant, Equipment, and Boiler Cost	$1,464,130.00

IV. SIMULATION RESULTS

The results of the analysis was an internal rate of return (IROR) of 17.4%, a composite rate of return (CROR) of 25.7%, and a breakeven point attained during the fifth year.

Unit price, the selling price of veneer, was the most sensitive variable, contributing to the largest variation in the IROR and CROR.

Results of the computer printout are given in Appendix B. Page 68 has the input data. The original cash equity was left blank to compute IROR. Another computer card was used to insert the original cash equity of $390,078.00, used to compute the CROR.

On page 69 the IROR is computed. This page and all following pages of Appendix B are divided into three parts. The first part is a summary of the basic financial parameters: investment cost, IROR or CROR, and financial ratios. The second part is the annual financial summary. The third part adjusts either IROR or CROR when unit sales, unit price, unit variable cost, total fixed cost and facilities cost are changed by plus or minus 10% or 20%.

Page 70 gives the financial summary with unit price adjusted so that IROR equals the alternate rate of return (AROR) of 18.5%. On page 71 the same thing is accomplished as on page 70, except that facilities cost and the factors dependent on facilities cost are adjusted so that IROR equals 18.5%, the AROR. On page 72 a financial summary is given considering $390,078.00 original cash equity, a borrowing rate of 8.7%, and a reinvestment rate of 10.5%. This information was used to compute the CROR.

On page 73 and page 74, similar treatment was given to CROR as was given to IROR on pages 70-71.

CHAPTER V

SUMMARY AND CONCLUSIONS

This study was undertaken to examine the feasibility of using yellow-poplar veneer in the southern pine plywood industry. To accomplish this, data was gathered in three problem areas. These were: technical restrictions, timber resource availability, and plant investment costs.

The technical restrictions of using yellow-poplar were examined. Yellow-poplar was found to be very suitable for veneer manufacture. The southern pine plywood plants that have used it have found that high speed equipment handles yellow-poplar well with only a few spin out problems. These problems may be relieved with further experience in log preparation and lathe handling.

One advantage yellow-poplar veneer has over yellow pine veneer is its uniform density. This uniformity facilitates handling yellow-poplar in the production process. It peels smoothly, dries evenly and glues well. A plywood panel with outer plys of yellow-poplar sands smoothly and takes finishes of paint or stain well, while retaining acceptable strength standards.

The availability of the resource was a primary concern. Yellow-poplar is concentrated in the areas in and around the southern Appalachian mountains. As a resource it is currently beind under-utilized. Management practices required to insure yellow-poplar regeneration and

restocking were found to be relatively simple and inexpensive to administer. The future appears bright for a steady supply of yellow-poplar.

In a 50 mile radius of either Asheville, North Carolina or Bristol, Tennessee, there were about five billion board feet of yellow-poplar and yellow pine sawtimber. A feasibility study of a plywood plant location completed in October of 1963 (3) showed about five billion board feet of sawtimber within a 50 mile radius for several selected cities in Georgia. Seven of the 15 areas identified now have softwood plywood plants in operation. Many other considerations besides resource availability for the study in 1963 hold true for the areas of the southern Appalachians. Proximity to markets, cheaper labor rates, and underutilization of a resource are some of these considerations.

There are 51.2 and 41.7 million board feet of yellow poplar and pinethat is assumed to be available for harvest in the Asheville and Bristol areas, respectively. The plant being considered would use 10.5 million board feet per year. The availability of timber seems to be substantial.

Log prices are low at the present time, but it would be expected that they would rise if a new wood-using industry were to be established in the area specified. Log costs are a part of variable cost and a 10% increase in variable cost would cause IROR to decrease by 4.5% as shown in the simulation. An IROR of 12.9% would make the feasibility of the plant questionable.

Finally, the manufacturing costs involved were examined. The economic feasibility of a plywood plant was assumed. The existence of many plywood producing plants in the southeast suggest that they are profitable.

The cost of a separate veneer plant was considerably higher than at first anticipated. An IROR of 17.4% and a CROR of 25.7% was attained from the simulation. If the 18.5% AROR is correct, the 17.4% IROR falls short and would suggest that the plant is not feasible. The uncertainty of the market for veneer in the southeast, together with the economics involved, leads the author to the opinion that either a complete plywood plant be built, or if a veneer plant only, it be by horizontal integration by firms owning plywood plants with a built-in marketing system. The marketing of the new product was not studied and is one important area that warrants investigation prior to the establishment of a veneer plant using yellow-poplar.

A stable veneer market would be a very critical factor in a veneer plant's success. In the southern pine portion of the industry, buying and selling of plywood, not veneer, is the common practice, and therefore the stability of a veneer market is unknown.

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LITERATURE CITED

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APPENDIXES

APPENDIX A

EQUIPMENT PROPOSAL

Painesville, Ohio U.S.A. Feb. 28, 1978

The Coe Manufacturing Company (herinafter called Company) propose to furnish

TENNESSEE VALLEY AUTHORITY, NORRIS, TENNESSEE

(hereinafter called Purchaser) F. O. B. Cars Factory, Painesville, O., U.S.A., the machinery covered by the following description and dimension sheet.

ROTARY VENEER MANUFACTURING PLANT

Raw Material:

Round logs having an average diameter of 12", a maximum diameter of 48" and a maximum length (at lathe) of 109".

Finished Product:

1/6" thick veneer of size approximately 50" by 100". Different thicknesses as well as smaller sizes can also be produced.

Daily Capacity:

Based on operating the veneer dryer 24 hours per day and the balance of the equipment 8 hours per day of 24 hours, we estimate the equipment, when properly installed and operated, should be capable of producing 221,130 square feet of 1/6" veneer per day (36,855 board feet).

Specifications:

Quotation is based upon shipping from the factories all of the machinery as outlined in the following specifications, together with electric motors, starting controls and drives. It is assumed that 440 Volt, 3 Phase, 60 Hertz electric current will be delivered to the mill and suitable boiler and air compressor will be provided for steam and air requirements. Price does not include electrical wiring, piping, boiler pumps, building, etc., or any other material not specifically stated in the specifications.

Equipment:

1. One (1) only Coe single 20 foot primary conveyor, 10 h.p. drive, one (1) set of hydraulic pin stops and a hydraulic even-ender.

   Price, f.o.b. factory, Portland, Oregon $22,950

2. One (1) only Coe Model 760 pendulum type lathe charger, 48" diameter by 109", equipped with geometric centering only.

   Price, f.o.b. factory, Portland, Oregon $46,000

3. One (1) only Coe Model 263-D lathe, 48" swing by 109" knife length, with dual hydraulic spindles, 6-1/2" and 3-1/2" diameter, complete with:

   a) Motorized pitch adjustment
   b) Auto carriage retract
   c) Model 262 heavy duty knife and pressure bar
   d) Motorized pressure bar adjustment
   e) Air operated pressure bar
   f) Ball bearing feed screw nuts
   g) Two speed carriage motor, Airflex brake and blower
   h) Coupling for direct drive
   i) Air operated special ratio two thickness gear
   j) Two (2) 70 g.p.m. pumping units
   k) Air operated center spur block

   Price f.o.b. factory, Painesville, Ohio $125,425

4. One (1) only Coe Style C-4 lathe back-up roll for use with 48" maximum log. (Reference: See last page of Bulletin No. 700.)

   Price, f.o.b. factory, Painesville, Ohio $12,400

5. One (1) only Redco electric 125 h.p. D.C. lathe drive with constant sheet speed control, compensating starter and prewiring, including 200 h.p. A.C. motor and 125 KW generator.

   Price, f.o.b. factory, Painesville, Ohio $49,310

6. One (1) Coe tray system consisting of three (3) decks, each 100 feet long, with lathe apron, trash gate, single tipple, sheet breaker but without electric drive. (Intermediate supports by Customer.)

   Price, f.o.b. factory, Painesville, Ohio $44,425

6-A One (1) only Redco tray system drive, Model III, consisting of 15 h.p. deck drive and 10 h.p. tipple motor and with automatic deck selection.

Price, f.o.b.factory, Seattle, Washington $22,625

7. One (1) Coe Model 369 split knife, 113" green clipper, equipped with:

a) One (1) 20 foot infeed table and 5 foot outfeed table
b) 7-1/2 h.p. D.C. drive
c) 50 foot grading table
d) Digital timer for automatic clipping of three (3) widths and for manual defect clipping (two timers included).

Price, f.o.b. factory, Painesville, Ohio $56,325

8. One (1) Coe Model 73 four deck veneer dryer feeder with "X" lift and fixed pre-load conveyor.

Price, f.o.b. factory, Painesville, Ohio $38,850

9. One (1) Coe Model 72 - 12 section, 4 line, steam heated Vert-A-Jet dryer, 15'-0" roll length, with two (2) forced draft cooling sections.

Price, f.o.b. factory, Painesville, Ohio $363,600

10. One (1) Coe Model 975 veneer dryer unloader with 5 h.p. independent variable drive.

Price, f.o.b. factory, Portland, Oregon $24,275

11. One (1) Coe dryer unloader discharge apron.

Price, f.o.b. factory, Portland, Oregon $13,925

12. Two (2) Coe Style "W", 110" dry veneer sizing clippers with 7-1/2 h.p. motors

Price, f.o.b. factory, Painesville, Ohio @ $8,375 $16,750

13. One (1) Coe-Skoog veneer patcher with one (1) five-piece and one (1) three-piece die set for a spare.

Price, f.o.b. factory, Portland, Oregon $29,575

14	One (1) Coe Model 431, 135" knife grinder with coolant pump and pan.	
	Price, f.o.b. factory, Painesville, Ohio	$23,625
15.	Eight (8) Block Steam Vats	
	Price, f.o.b.	$20,675
16.	One (1) Log yard fork lift truck	
	Price, f.o.b.	$22,100
17.	One (1) Deck or pond saw	
	Price, f.o.b.	$5,360
18.	One (1) Rosser Head debarker	
	Price, f.o.b.	$37,460
19.	Two (2) Fork lift trucks	
	Price, f.o.b.	$39,780
20.	One (1) set of miscellaneous maintenance tools	
	Price, f.o.b.	$23,760
21.	One (1) set of yard equipment tools (chain saws, cant-hooks, etc.)	
	Price, f.o.b.	$2,210
22.	One (1) Main veneer trash conveyor at lathe	
	Price, f.o.b.	$14,365
23.	One (1) Package boiler for generating steam for dryer and press	
	Price, f.o.b.	$55,250
24.	One (1) Steel chain core conveyor at lathe	
	Price, f.o.b.	$7,520

25. One (1) Veneer hog

Price, f.o.b. $14,365

26. One (1) Core chipper

Price, f.o.b. $24,870

27. Four (4) American X-lifts

Price, f.o.b. $11,605

Prices:

Prices are subject to an increase or decrease in proportion to any increase or decrease as listed under the Index entitled, "General Purpose Machinery and Equipment", Code No. 11.4, published monthly by the U. S. Department of Labor. The period of escalation includes the month in which the equipment is proposed through the month in which the bulk of the material is shipped.

Terms:

25% down payment due with order
65% due upon shipment
10% due 90 days after shipment

Shipment:

We estimate that this material will be ready for shipment within seven to nine months after our receipt of your formal purchase order and finalization of technical details.

This contract is contingent upon strikes, fires, accidents, lack of or inability to obtain raw materials, labor, fuel or supplies or other delays unavoidable or beyond the reasonable control of the company.

Note: Items 15 through 27 are from previous communication with The Coe Manufacturing Company, Painesville, Ohio 44077, June 29, 1976 and prices were made current by using a wholesale price index of 10.5.

APPENDIX B

THE CASH FLOW ANALYSIS PROGRAM (CFA)
WRITTEN BY GEORGE HARPOLE
USDA FOREST PRODUCTS LABORATORY
MADISON WISCONSIN
ADAPTED BY: TENNESSEE VALLEY AUTHORITY
FOREST MANAGEMENT AND INDUSTRY DEVELOPMENT
NORRIS TENNESSEE 37828

THE CASH FLOW ANALYSIS (CFA) PROGRAM IS WRITTEN TO BE USED FOR THE ANALYSIS OF CONVENTIONAL MANUFACTURING INVESTMENTS OVER TIME PERIODS OF FROM 2 TO 20 YEARS. THE OUTPUTS OF THE PROGRAM ARE FORMULATED TO PROVIDE A ONE OR TWO PAGE SUMMARY OF CASH FLOWS AND COMPUTATIONAL RESULTS THAT MAY BE USED FOR ECONOMIC ASSESSMENTS. A TWO PAGE SUMMARY WILL BE PRINTED ONLY WHEN THE TIME FRAME OF ANALYSIS EXCEEDS 10 YEARS.

IN SUMMARY, THE CFA PROGRAM IS DESIGNED TO COMPUTE THE AFTER-TAX TIME VALUE OF INVESTMENT CAPITAL, OPERATING COSTS, AND REVENUE CASH FLOWS IN TERMS OF FOUR PRINCIPLE TYPES OF INVESTMENT CRITERIA: (1) THE PRESENT VALUE OF THE INVESTMENT. (2) THE RATE OF RETURN ON INVESTMENT. (3) THE TOTAL UNIT COST(S) OF PRODUCTION, INCLUDING TAXES AND PROFIT. (4) THE MAXIMUM INVESTMENT(S) THAT CAN BE MADE TO OBTAIN A MINIMALLY ATTRACTIVE RATE OF RETURN.

THE PRESENT VALUE OF THE INVESTMENT (PVI) IS DEFINED BY THE DISCOUNT RATE ENTERED IN THE CFA PROGRAM. THAT IS, PVI IS THE PRESENT VALUE, OR NET PRESENT WORTH OF THE STREAM OF ANNUAL NET CASH FLOWS DISCOUNTED BY THE DISCOUNT RATE ENTERED INTO THE ANALYSIS. IF THE DISCOUNT RATE SPECIFIED IS THE SAME AS THE RATE OF RETURN THAT COULD BE REALIZED FROM ALTERNATIVE INVESTMENTS WITH SIMILAR RISK (THE OPPORTUNITY COST OF MONEY CAPITAL) THE PVI MAY BE USED AS A BASIS FOR COMPARING CFA CONSIDERED PROJECTS TO ALTERNATIVE INVESTMENT OPPORTUNITIES.

THE CFA PROGRAM CALCULATES TWO TYPES OF RATE-OF- RETURN (ROR) CRITERIA. ONE IS AN INTERNAL ROR. THIS IS THE PARTICULAR RATE OF INTEREST REQUIRED TO DISCOUNT THE STREAM OF ANNUAL NET CASH FLOWS TO A PRESENT VALUE OF ZERO. FOR COMPLEX INVESTMENT PROJECTS WHERE THERE MAY BE MORE THAN ONE INTERNAL ROR. THE CFA PROGRAM WILL COMPUTE ONLY THE INTERNAL ROR CLOSEST TO THE DISCOUNT RATE USED. THE SECOND TYPE OF ROR CALCULATED IS A COMPOSITE ROR WHICH EXPRESSES THE ROR TO EQUITY CAPITAL INVESTED AT THE INITIATION OF A PROJECT. THIS ROR IS REFERRED TO AS A COMPOSITE ROR BECAUSE IT IS COMPUTED AS A ROR TO EQUITY CAPITAL AS A COMPOSITE TO THE RATE OF INTEREST SPECIFIED FOR MONIES THAT MAY BE BORROWED TO FINANCE THE PROJECT AND THE RATE OF INTEREST SPECIFIED FOR REINVESTED CASH SURPLUSES. THE LOWEST VALUE THAT THE CFA PROGRAM WILL COMPUTE FOR EITHER ROR IS -0.999.

THE TOTAL UNIT COST OF PRODUCTION IS PRICE-VOLUME-COST BREAK-EVEN UNIT PRODUCT PRICE(S) REQUIRED TO YIELD AN AFTER TAX PROFIT CONSISTENT WITH EITHER AN INTERNAL OR COMPOSITE ROR EQUAL TO THE DISCOUNT RATE ENTERED INTO THE CFA ANALYSIS. THE BREAK-EVEN PRICE(S) INDICATE(S) THE PRICE(S) FOR WHICH PRODUCTS MUST BE SOLD TO ALLOW FOR SELLING, OPERATING, TAX AND CAPITAL RECOVERY COSTS AS WELL AS THE PROFITS PRESCRIBED BY THE DISCOUNT RATE USED.

THE MAXIMUM INVESTMENT(S) THAT CAN BE MADE AND STILL OBTAIN A MINIMALLY ATTRACTIVE ROR IS AGAIN A PRICE- VOLUME-COST BREAK-EVEN CALCULATION. IN THE CFA PROGRAM, TOTAL INVESTMENT IS DEFINED AS THE SUM OF THE FACILITIES AND WORKING CAPITAL INVESTMENT REQUIREMENTS. TO OBTAIN THE MAXIMUM INVESTMENT(S), OVERHEAD AND DEPRECIATION DATA INPUTS ARE ADJUSTED TO CORRESPOND TO THE FACILITIES COSTS AS FIXED PERCENTAGES.

THIS VERSION CONSIDERS INVESTMENT TAX CREDIT. THE ACTUAL DOLLAR AMOUNT TO BE CONSIDERED MUST BE PREDETERMINED AND ENTERED INTO THE PROGRAM.

ABSTRACT BY GEORGE HARPOLE

SOFTWOOD VENEER MANUFACTURING VENTURE **98415CU.FT./250 DAYS**

SELLING EXPENSE	WORKING CAPITAL	TAX RATE	DISCOUNT RATE	NUMBER YEARS	FINANCIAL ANALYSIS GE.1.=YES	PRICE/COST BREAK-EVEN GE.1.=YES	FACILITES BREAK-EVEN GE.1.=YES	ORIGINAL CASH INVESTMENT	SHORT-TERM BORROW RATE	SHORT-TERM REINVESTMENT RATE
0.0200	0.1800	0.5112	0.1850	10	1	1	1	0.	0.0	0.0

FACILITIES COST	INVESTMENT TAX CREDIT
1950390.	195039.

UNIT PRICE	UNIT SALES	UNIT MFG COSTS	OTHER VAR COSTS	FIXED MFG COST	OVERHEAD COST	FACILITIES COSTS	DEPRECIATION	YEAR
3.420	614249.	1.340	402485.	96000.	417400.	0.	292826.	1
3.630	767812.	1.420	426634.	101760.	442444.	0.	234261.	2
3.840	767812.	1.510	452232.	107866.	468991.	0.	187408.	3
4.070	767812.	1.600	479368.	114338.	497132.	0.	149927.	4
4.320	767812.	1.690	508129.	121198.	526959.	0.	119941.	5
4.580	767812.	1.790	538618.	128470.	558577.	0.	95953.	6
4.850	767812.	1.900	570933.	136178.	592090.	0.	76763.	7
5.140	767812.	2.010	605189.	144348.	627615.	0.	61410.	8
5.450	767812.	2.140	641500.	153010.	665273.	0.	49128.	9
5.730	767812.	2.260	679990.	162190.	705189.	-643476.	39302.	10

SEQUENTIAL RUN DATA

UNIT PRICE	UNIT SALES	UNIT MFG COSTS	OTHER VAR COSTS	FIXED MFG COST	OVERHEAD COST	ORIGINAL CASH INVESTMENT	SHORT-TERM BORROWING RATE	SHORT-TERM REINVESTMENT RATE
3.420	614250.	1.340	402485.	96000.	417400.	0.	0.0	0.0
3.420	614250.	1.340	402485.	96000.	417400.	390078.	0.0	0.0

SOFTWOOD VENEER MANUFACTURING VENTURE **98415CU.FT./250 DAYS**
(INVESTMENT TAX CREDIT OF $ 195039. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0		EFFECTIVE TAX RATE	.5112	ORIGINAL CASH EQUITY	$ 0.	VAR. COSTS/SALES	=0.5680
FACILITIES COST	$ 1950390.	BORROWING RATE	.0	ENDING VALUE OF EQUITY	$ 3438515.	FIXED COSTS/SALES	=0.2371
WORKING CAPITAL	$ 313016.	REINVESTMENT RATE	.0	FACILITIES SALVAGE VALUE	$ 643476.	TAX COSTS/SALES	=0.0939
TOTAL INVEST.	$ 2263405.	INTERNAL ROR	0.1740	P.V. OF INVST.(I=.1850)	$ -107942.	A.T. PROFIT/SALES	=0.1010

FINANCIAL SUMMARY

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	614249.	767812.	767812.	767812.	767812.	767812.	767812.	767812.	767812.	767812.
UNIT PRICE	$ 3.42	$ 3.63	$ 3.84	$ 4.07	$ 4.32	$ 4.58	$ 4.85	$ 5.14	$ 5.45	$ 5.73
GROSS SALES	$ 2100730.$	2787154.$	2948394.$	3124991.$	3316944.$	3516574.$	3723883.$	3946546.$	4184570.$	4399557.
INTEREST INC-EXP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROSS REVENUES	$ 2100730.$	2787154.$	2948394.$	3124991.$	3316944.$	3516574.$	3723883.$	3946546.$	4184570.$	4399557.
VARIABLE MFG COST	$ 823093.$	1090291.$	1159394.$	1228497.$	1297601.$	1374382.$	1458841.$	1543300.$	1643116.$	1735253.
SELLING EXPENSE	42015.	55743.	58968.	62500.	66339.	70331.	74478.	78931.	83691.	87991.
OTHER VAR. COST	402485.	426634.	452232.	479368.	508129.	538618.	570933.	605189.	641500.	679990.
TOTAL VAR COST	$ 1267592.$	1572667.$	1670592.$	1770363.$	1872067.$	1983330.$	2104250.$	2227418.$	2368306.$	2503233.
UNIT VAR COST	$ 2.06	$ 2.05	$ 2.18	$ 2.31	$ 2.44	$ 2.58	$ 2.74	$ 2.90	$ 3.08	$ 3.26
PROFIT CONTRI	$ 833138.$	1214487.$	1277802.$	1354628.$	1444877.$	1533244.$	1619633.$	1719128.$	1816264.$	1896324.
FIXED MFG COST	$ 96000.$	101760.$	107866.$	114338.$	121198.$	128470.$	136178.$	144348.$	153010.$	162190.
OVERHEAD COST	417400.	442444.	468991.	497132.	526959.	558577.	592090.	627615.	665273.	705189.
TOTAL F.C.	$ 513400.$	544204.$	576857.$	611470.$	648157.$	687047.$	728268.$	771963.$	818283.$	867379.
FACILITIES COST	$ 0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	-643476.
WORKING CAPITAL	57987.	22924.	23553.	24219.	26309.	28439.	29234.	32840.	32350.	-590871.
INVESTMENT	$ 57987.$	22924.$	23553.$	24219.$	26309.$	28439.$	29234.$	32840.$	32350.$	-1234347.
DEPRECIATION	$ 292826.$	234261.$	187408.$	149927.$	119941.$	95953.$	76763.$	61410.$	49128.$	39302.
AFTER TAX PROFIT	$ 208194.$	213128.$	251017.$	289972.$	330810.$	366720.$	398178.$	432957.$	463800.$	483738.
A.T. EARNINGS	501019.	447389.	438425.	439898.	450751.	462672.	474941.	494367.	512927.	523040.
A.T. NET CASH FLOW	443032.	424465.	414872.	415679.	424442.	434233.	445707.	461527.	480577.	1757386.
ACUM NET CASH FLOW	$ -1820.4M	$ -1395.9M	$ -981.0M	$ -565.4M	$ -140.9M	$ 293.3M	$ 739.0M	$ 1200.6M	$ 1681.1M	$ 3438.5M

INTERNAL RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	0.084	0.131	0.174	0.213	0.250
UNIT PRICE	0.011	0.098	0.174	0.241	0.305
UNIT VAR COST	0.260	0.217	0.174	0.129	0.082
TOTAL F.C.	0.204	0.188	0.174	0.158	0.142
FACILITIES COST	0.203	0.187	0.174	0.161	0.151

SOFTWOOD VENEER MANUFACTURING VENTURE **98415CU.FT./250 DAYS**
(INVESTMENT TAX CREDIT OF $ 195039. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0		EFFECTIVE TAX RATE	.5112	ORIGINAL CASH EQUITY	$ 0.	VAR. COSTS/SALES	=0.5591
FACILITIES COST	$ 1950388.	BORROWING RATE	.0	ENDING VALUE OF EQUITY	$ 3707398.	FIXED COSTS/SALES	=0.2333
WORKING CAPITAL	$ 313015.	REINVESTMENT RATE	.0	FACILITIES SALVAGE VALUE	$ 643475.	TAX COSTS/SALES	=0.1005
TOTAL INVEST.	$ 2263403.	INTERNAL ROR	0.1850	P.V. OF INVST.(I=.1850)	$ -7.	A.T. PROFIT/SALES	=0.1071

FINANCIAL SUMMARY WITH BREAK-EVEN ADJUSTED UNIT PRICES

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	614249.	767811.	767811.	767811.	767811.	767811.	767811.	767811.	767811.	767811.
UNIT PRICE $	3.48 $	3.69 $	3.90 $	4.14 $	4.39 $	4.66 $	4.93 $	5.22 $	5.54 $	5.82
GROSS SALES $	2135361.$	2833100.$	2996999.$	3176506.$	3371624.$	3574545.$	3785271.$	4011605.$	4253553.$	4472083.
INTEREST INC-EXP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROSS REVENUES $	2135361.$	2833100.$	2996999.$	3176506.$	3371624.$	3574545.$	3785271.$	4011605.$	4253553.$	4472083.
VARIABLE MFG COST $	823093.$	1090290.$	1159393.$	1228496.$	1297599.$	1374381.$	1458840.$	1543299.$	1643114.$	1735252.
SELLING EXPENSE	42707.	56662.	59940.	63530.	67432.	71491.	75705.	80232.	85071.	89442.
OTHER VAR. COST	402485.	426634.	452232.	479368.	508129.	538618.	570933.	605189.	641500.	679990.
TOTAL VAR COST $	1268284.$	1573584.$	1671563.$	1771393.$	1873159.$	1984488.$	2105477.$	2228719.$	2369684.$	2504682.
UNIT VAR COST $	2.06 $	2.05 $	2.18 $	2.31 $	2.44 $	2.58 $	2.74 $	2.90 $	3.09 $	3.26
PROFIT CONTRI $	867077.$	1259516.$	1325436.$	1405113.$	1498465.$	1590057.$	1679794.$	1782886.$	1883869.$	1967401.
FIXED MFG COST $	96000.$	101760.$	107866.$	114338.$	121198.$	128470.$	136178.$	144348.$	153010.$	162190.
OVERHEAD COST	417400.	442444.	468991.	497132.	526959.	558577.	592090.	627615.	665273.	705189.
TOTAL F.C. $	513400.$	544204.$	576857.$	611470.$	648157.$	687047.$	728268.$	771963.$	818283.$	867379.
FACILITIES COST $	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	-643475.
WORKING CAPITAL	57987.	22924.	23553.	24219.	26309.	28439.	29234.	32840.	32350.	-590871.
INVESTMENT $	57987.$	22924.$	23553.$	24219.$	26309.$	28439.$	29234.$	32840.$	32350.$	-1234346.
DEPRECIATION $	292826.$	234261.$	187408.$	149927.$	119941.$	95953.$	76763.$	61410.$	49128.$	39302.
AFTER TAX PROFIT $	224783.$	235138.$	274301.$	314649.$	357004.$	394490.$	427584.$	464122.$	496845.$	518480.
A.T. EARNINGS	517609.	469399.	461708.	464575.	476944.	490443.	504347.	525532.	545973.	557782.
A.T. NET CASH FLOW	459622.	446475.	438155.	440356.	450636.	462003.	475114.	492692.	513622.	1792127.
ACUM NET CASH FLOW $	-1803.8M $	-1357.3M $	-919.2M $	-478.8M $	-28.2M $	433.8M $	909.0M $	1401.6M $	1915.3M $	3707.4M

INTERNAL RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	0.095	0.142	0.185	0.225	0.262
UNIT PRICE	0.023	0.110	0.185	0.253	0.318
UNIT VAR COST	0.271	0.228	0.185	0.141	0.095
TOTAL F.C.	0.215	0.200	0.185	0.170	0.154
FACILITIES COST	0.217	0.199	0.185	0.173	0.161

SOFTWOOD VENEER MANUFACTURING VENTURE **98415CU.FT./250 DAYS**
(INVESTMENT TAX CREDIT OF $ 186474. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0		EFFECTIVE TAX RATE	.5112	ORIGINAL CASH EQUITY	$ 0.	VAR. COSTS/SALES	=0.5680
FACILITIES COST	$ 1864741.	BORROWING RATE	.0	ENDING VALUE OF EQUITY	$ 3576077.	FIXED COSTS/SALES	=0.2283
WORKING CAPITAL	$ 309716.	REINVESTMENT RATE	.0	FACILITIES SALVAGE VALUE	$ 615215.	TAX COSTS/SALES	=0.0986
TOTAL INVEST.	$ 2174457.	INTERNAL ROR	0.1850	P.V. OF INVST.(I=.1850)	$ 8.	A.T. PROFIT/SALES	=0.1050

FINANCIAL SUMMARY WITH BREAK-EVEN ADJUSTED FACILITIES COST(S), DEPRECIATION AND OVERHEAD

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	614249.	767811.	767811.	767811.	767811.	767811.	767811.	767811.	767811.	767811.
UNIT PRICE	$ 3.42	$ 3.63	$ 3.84	$ 4.07	$ 4.32	$ 4.58	$ 4.85	$ 5.14	$ 5.45	$ 5.73
GROSS SALES	$ 2100728.$	2787149.$	2948389.$	3124986.$	3316939.$	3516568.$	3723877.$	3946540.$	4184564.$	4399550.
INTEREST INC-EXP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROSS REVENUES	$ 2100728.$	2787149.$	2948389.$	3124986.$	3316939.$	3516568.$	3723877.$	3946540.$	4184564.$	4399550.
VARIABLE MFG COST	$ 823092.$	1090289.$	1159392.$	1228495.$	1297598.$	1374380.$	1458839.$	1543298.$	1643113.$	1735250.
SELLING EXPENSE	42015.	55743.	58968.	62500.	66339.	70331.	74478.	78931.	83691.	87991.
OTHER VAR. COST	402485.	426634.	452232.	479368.	508129.	538618.	570933.	605189.	641500.	679990.
TOTAL VAR COST	$ 1267591.$	1572664.$	1670590.$	1770361.$	1872064.$	1983328.$	2104248.$	2227416.$	2368303.$	2503229.
UNIT VAR COST	$ 2.06	$ 2.05	$ 2.18	$ 2.31	$ 2.44	$ 2.58	$ 2.74	$ 2.90	$ 3.08	$ 3.26
PROFIT CONTRI	$ 833137.$	1214485.$	1277799.$	1354625.$	1444875.$	1533240.$	1619629.$	1719124.$	1816261.$	1896321.
FIXED MFG COST	$ 96000.$	101760.$	107866.$	114338.$	121198.$	128470.$	136178.$	144348.$	153010.$	162190.
OVERHEAD COST	399070.	423015.	448396.	475301.	503818.	534048.	566089.	600054.	636058.	674221.
TOTAL F.C.	$ 495070.$	524775.$	556262.$	589639.$	625016.$	662518.$	702267.$	744402.$	789068.$	836411.
FACILITIES COST	$ 0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	-615215.
WORKING CAPITAL	57789.	22714.	23331.	23984.	26059.	28174.	28953.	32543.	32035.	-585297.
INVESTMENT	$ 57789.$	22714.$	23331.$	23984.$	26059.$	28174.$	28953.$	32543.$	32035.$	-1200511.
DEPRECIATION	$ 279967.$	223974.$	179178.$	143343.$	114674.$	91739.$	73392.$	58713.$	46971.$	37576.
AFTER TAX PROFIT	$ 214873.$	227652.$	265105.$	303859.$	344694.$	380767.$	412533.$	447745.$	479133.$	499716.
A.T. EARNINGS	494840.	451626.	444283.	447202.	459368.	472506.	485925.	506458.	526103.	537292.
A.T. NET CASH FLOW	437052.	428912.	420952.	423219.	433309.	444332.	456972.	473916.	494069.	1737803.
ACUM NET CASH FLOW	$ -1737.4M	$ -1308.5M	$ -887.5M	$ -464.3M	$ -31.0M	$ 413.3M	$ 870.3M	$ 1344.2M	$ 1838.3M	$ 3576.1M

INTERNAL RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	0.094	0.142	0.185	0.225	0.263
UNIT PRICE	0.019	0.108	0.185	0.255	0.320
UNIT VAR COST	0.274	0.230	0.185	0.139	0.091
TOTAL F.C.	0.215	0.200	0.185	0.170	0.154
FACILITIES COST	0.216	0.199	0.185	0.173	0.161

SOFTWOOD VENEER MANUFACTURING VENTURE **98415CU.FT./250 DAYS**
(INVESTMENT TAX CREDIT OF $ 195039. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0	EFFECTIVE TAX RATE .5112	ORIGINAL CASH EQUITY	$ 390078.	VAR. COSTS/SALES =0.5680	
FACILITIES COST $ 1950390.	BORROWING RATE .0870	ENDING VALUE OF EQUITY	$ 3828836.	FIXED COSTS/SALES=0.2371	
WORKING CAPITAL $ 313016.	REINVESTMENT RATE .1050	FACILITIES SALVAGE VALUE	$ 643476.	TAX COSTS/SALES =0.0939	
TOTAL INVEST. $ 2263405.	COMPOSITE ROR 0.2566	P.V. OF EQUITY(I=.1850)	$ 701274.	A.T. PROFIT/SALES=0.1010	

FINANCIAL SUMMARY

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	614250.	767811.	767811.	767811.	767811.	767811.	767811.	767811.	767811.	767811.
UNIT PRICE $	3.42 $	3.63 $	3.84 $	4.07 $	4.32 $	4.58 $	4.85 $	5.14 $	5.45 $	5.73
GROSS SALES $	2100731.$	2787152.$	2948393.$	3124989.$	3316942.$	3516571.$	3723880.$	3946543.$	4184568.$	4399554.
INTEREST INC-EXP	-162979.	-131366.	-100024.	-68184.	-34920.	630.	46256.	95429.	148787.	206884.
GROSS REVENUES $	1937751.$	2655785.$	2848368.$	3056805.$	3282022.$	3517200.$	3770136.$	4041972.$	4333355.$	4606438.
VARIABLE MFG COST $	823093.$	1090290.$	1159393.$	1228496.$	1297599.$	1374381.$	1458841.$	1543299.$	1643115.$	1735252.
SELLING EXPENSE	42015.	55743.	58968.	62500.	66339.	70331.	74478.	78931.	83691.	87991.
OTHER VAR. COST	402485.	426634.	452232.	479368.	508129.	538618.	570933.	605189.	641500.	679990.
TOTAL VAR COST $	1267592.$	1572666.$	1670591.$	1770362.$	1872065.$	1983329.$	2104251.$	2227417.$	2368305.$	2503232.
UNIT VAR COST $	2.06 $	2.05 $	2.18 $	2.31 $	2.44 $	2.58 $	2.74 $	2.90 $	3.08 $	3.26
PROFIT CONTRI $	670159.$	1083119.$	1177777.$	1286443.$	1409957.$	1533871.$	1665885.$	1814555.$	1965050.$	2103206.
FIXED MFG COST $	96000.$	101760.$	107866.$	114338.$	121198.$	128470.$	136178.$	144348.$	153010.$	162190.
OVERHEAD COST	417400.	442444.	468991.	497132.	526959.	558577.	592090.	627615.	665273.	705189.
TOTAL F.C. $	513400.$	544204.$	576857.$	611470.$	648157.$	687047.$	728268.$	771963.$	818283.$	867379.
FACILITIES COST $	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	-643476.
WORKING CAPITAL	57987.	22924.	23553.	24219.	26309.	28439.	29233.	32840.	32350.	-590871.
INVESTMENT $	57987.$	22924.$	23553.$	24219.$	26309.$	28439.$	29233.$	32840.$	32350.$	-1234347.
DEPRECIATION $	292826.$	234261.$	187408.$	149927.$	119941.$	95953.$	76763.$	61410.$	49128.$	39302.
AFTER TAX PROFIT $	128530.$	148915.$	202125.$	256643.$	313741.$	367026.$	420786.$	479602.$	536526.$	584861.
A.T. EARNINGS	421355.	383176.	389533.	406570.	433682.	462979.	497549.	541012.	585654.	624163.
A.T. NET CASH FLOW	363368.	360252.	365979.	382350.	407373.	434539.	468315.	508171.	553304.	1858510.
ACUM NET CASH FLOW $	-1900.0M $	-1539.8M $	-1173.8M $	-791.5M $	-384.1M $	50.5M $	518.8M $	1026.9M $	1580.2M $	3438.8M
BEGINING-OF-YEAR VALUES FOR MONIES . . .										
BORROWED $	1873.3M $	1510.0M $	1149.7M $	783.7M $	401.4M $	0.0M $	0.0M $	0.0M $	0.0M $	0.0M
REINVESTED $	0.0M $	0.0M $	0.0M $	0.0M $	0.0M $	6.0M $	440.5M $	908.9M $	1417.0M $	1970.3M

COMPOSITE RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	0.143	0.211	0.257	0.291	0.318
UNIT PRICE	*****	0.169	0.257	0.310	0.350
UNIT VAR COST	0.318	0.291	0.257	0.212	0.145
TOTAL F.C.	0.281	0.270	0.257	0.242	0.227
FACILITIES COST	0.289	0.272	0.257	0.243	0.230

SOFTWOOD VENEER MANUFACTURING VENTURE **98415CU.FT./250 DAYS**
(INVESTMENT TAX CREDIT OF $ 195039. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0		EFFECTIVE TAX RATE	.5112	ORIGINAL CASH EQUITY	$ 390078.	VAR. COSTS/SALES	=0.6195
FACILITIES COST	$ 1950388.	BORROWING RATE	.0870	ENDING VALUE OF EQUITY	$ 2129903.	FIXED COSTS/SALES	=0.2790
WORKING CAPITAL	$ 313016.	REINVESTMENT RATE	.1050	FACILITIES SALVAGE VALUE	$ 643475.	TAX COSTS/SALES	=0.0456
TOTAL INVEST.	$ 2263403.	COMPOSITE ROR	0.1850	P.V. OF EQUITY(I=.1850)	$ 390106.	A.T. PROFIT/SALES	=0.0559

FINANCIAL SUMMARY WITH BREAK-EVEN ADJUSTED UNIT PRICES

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	614249.	767811.	767811.	767811.	767811.	767811.	767811.	767811.	767811.	767811.
UNIT PRICE $	3.13 $	3.32 $	3.51 $	3.72 $	3.95 $	4.19 $	4.43 $	4.70 $	4.98 $	5.24
GROSS SALES $	1920380.$	2547870.$	2695266.$	2856703.$	3032176.$	3214668.$	3404177.$	3607725.$	3825317.$	4021846.
INTEREST INC-EXP	-162979.	-138882.	-117832.	-97298.	-76452.	-54645.	-31772.	-7671.	21767.	55275.
GROSS REVENUES $	1757400.$	2408987.$	2577434.$	2759405.$	2955723.$	3160023.$	3372404.$	3600054.$	3847084.$	4077121.
VARIABLE MFG COST $	823093.$	1090289.$	1159392.$	1228495.$	1297598.$	1374380.$	1458839.$	1543298.$	1643114.$	1735251.
SELLING EXPENSE	38408.	50957.	53905.	57134.	60644.	64293.	68084.	72154.	76506.	80437.
OTHER VAR. COST	402485.	426634.	452232.	479368.	508129.	538618.	570933.	605189.	641500.	679990.
TOTAL VAR COST $	1263985.$	1567879.$	1665528.$	1764996.$	1866369.$	1977290.$	2097855.$	2220640.$	2361119.$	2495676.
UNIT VAR COST $	2.06 $	2.04 $	2.17 $	2.30 $	2.43 $	2.58 $	2.73 $	2.89 $	3.08 $	3.25
PROFIT CONTRI $	493415.$	841108.$	911906.$	994409.$	1089354.$	1182733.$	1274549.$	1379414.$	1485965.$	1581445.
FIXED MFG COST $	96000.$	101760.$	107866.$	114338.$	121198.$	128470.$	136178.$	144348.$	153010.$	162190.
OVERHEAD COST	417400.	442444.	468991.	497132.	526959.	558577.	592090.	627615.	665273.	705189.
TOTAL F.C. $	513400.$	544204.$	576857.$	611470.$	648157.$	687047.$	728268.$	771963.$	818283.$	867379.
FACILITIES COST $	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	-643475.
WORKING CAPITAL	57987.	22924.	23554.	24219.	26309.	28439.	29234.	32841.	32350.	-590871.
INVESTMENT $	57987.$	22924.$	23554.$	24219.$	26309.$	28439.$	29234.$	32841.$	32350.$	-1234345.
DEPRECIATION $	292826.$	234261.$	187408.$	149927.$	119941.$	95953.$	76763.$	61410.$	49128.$	39302.
AFTER TAX PROFIT $	42137.$	30620.$	72167.$	113897.$	157030.$	195390.$	229501.$	266905.$	302349.$	329825.
A.T. EARNINGS	334563.	264881.	259575.	263823.	276971.	291342.	306263.	328315.	351477.	369127.
A.T. NET CASH FLOW	276976.	241957.	236021.	239604.	250662.	262903.	277030.	295474.	319127.	1603471.
ACUM NET CASH FLOW $	-1986.4M $	-1744.5M $	-1508.4M $	-1268.8M $	-1018.2M $	-755.3M $	-478.2M $	-182.8M $	136.4M $	1739.8M
BEGINING-OF-YEAR VALUES FOR MONIES . . .										
BORROWED $	1873.3M $	1596.3M $	1354.4M $	1118.4M $	878.8M $	628.1M $	365.2M $	88.2M $	0.0M $	0.0M
REINVESTED $	0.0M $	0.0M $	0.0M $	0.0M $	0.0M $	0.0M $	0.0M $	0.0M $	207.3M $	526.4M

COMPOSITE RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	-.087	0.113	0.185	0.232	0.266
UNIT PRICE	*****	-.010	0.185	0.260	0.309
UNIT VAR COST	0.276	0.238	0.185	0.097	*****
TOTAL F.C.	0.224	0.206	0.185	0.160	0.130
FACILITIES COST	0.218	0.201	0.185	0.170	0.157

SOFTWOOD VENEER MANUFACTURING VENTURE **98615CU.FT./250 DAYS**
(INVESTMENT TAX CREDIT OF $ 249640. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0		EFFECTIVE TAX RATE	.5112	ORIGINAL CASH EQUITY	$ 499280.	VAR. COSTS/SALES	=0.5680
FACILITIES COST	$ 2496397.	BORROWING RATE	.0870	ENDING VALUE OF EQUITY	$ 2726150.	FIXED COSTS/SALES	=0.3132
WORKING CAPITAL	$ 334049.	REINVESTMENT RATE	.1050	FACILITIES SALVAGE VALUE	$ 823611.	TAX COSTS/SALES	=0.0534
TOTAL INVEST.	$ 2830445.	COMPOSITE ROR	0.1850	P.V. OF EQUITY(I=.1850)	$ 499312.	A.T. PROFIT/SALES	=0.0654

FINANCIAL SUMMARY WITH BREAK-EVEN ADJUSTED FACILITIES COST(S), DEPRECIATION AND OVERHEAD

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	614249.	767810.	767810.	767810.	767810.	767810.	767810.	767810.	767810.	767810.
UNIT PRICE	$ 3.42	$ 3.63	$ 3.84	$ 4.07	$ 4.32	$ 4.58	$ 4.85	$ 5.14	$ 5.45	$ 5.73
GROSS SALES	$ 2100729.$	2787148.$	2948388.$	3124984.$	3316937.$	3516566.$	3723874.$	3946537.$	4184561.$	4399547.
INTEREST INC-EXP	-202811.	-169575.	-142325.	-115657.	-88594.	-60353.	-30744.	574.	40770.	84291.
GROSS REVENUES	$ 1897917.$	2617573.$	2806063.$	3009327.$	3228343.$	3456212.$	3693129.$	3947111.$	4225330.$	4483837.
VARIABLE MFG COST	$ 823093.$	1090288.$	1159391.$	1228494.$	1297597.$	1374379.$	1458838.$	1543296.$	1643112.$	1735250.
SELLING EXPENSE	42015.	55743.	58968.	62500.	66339.	70331.	74477.	78931.	83691.	87991.
OTHER VAR. COST	402485.	426634.	452232.	479368.	508129.	538618.	570933.	605189.	641500.	679990.
TOTAL VAR COST	$ 1267592.$	1572663.$	1670589.$	1770360.$	1872063.$	1983327.$	2104248.$	2227414.$	2368302.$	2503229.
UNIT VAR COST	$ 2.06	$ 2.05	$ 2.18	$ 2.31	$ 2.44	$ 2.58	$ 2.74	$ 2.90	$ 3.08	$ 3.26
PROFIT CONTRI	$ 630325.$	1044910.$	1135474.$	1238967.$	1356280.$	1472885.$	1588881.$	1719697.$	1857028.$	1980608.
FIXED MFG COST	$ 96000.$	101760.$	107866.$	114338.$	121198.$	128470.$	136178.$	144348.$	153010.$	162190.
OVERHEAD COST	534250.	566305.	600284.	636303.	674480.	714949.	757844.	803314.	851515.	902605.
TOTAL F.C.	$ 630250.$	668065.$	708150.$	750641.$	795678.$	843419.$	894022.$	947662.$	1004525.$	1064794.
FACILITIES COST	$ 0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	-823611.
WORKING CAPITAL	59248.	24261.	24971.	25722.	27902.	30128.	31024.	34738.	34362.	-626406.
INVESTMENT	$ 59248.$	24261.$	24971.$	25722.$	27902.$	30128.$	31024.$	34738.$	34362.$	-1450016.
DEPRECIATION	$ 374803.$	299842.$	239873.$	191899.$	153518.$	122815.$	98252.$	78601.$	62881.$	50305.
AFTER TAX PROFIT	$ 66473.$	37639.$	91626.$	144894.$	198983.$	247651.$	291621.$	338950.$	385967.$	423061.
A.T. EARNINGS	441276.	337481.	331499.	336793.	352501.	370466.	389874.	417552.	448849.	473366.
A.T. NET CASH FLOW	382027.	313220.	306528.	311070.	324599.	340338.	358850.	382814.	414487.	1923381.
ACUM NET CASH FLOW	$ -2448.4M	$ -2135.2M	$ -1828.7M	$ -1517.6M	$ -1193.0M	$ -852.7M	$ -493.8M	$ -111.0M	$ 303.5M	$ 2226.9M
BEGINING-OF-YEAR VALUES FOR MONIES . . .										
BORROWED	$ 2331.2M	$ 1949.1M	$ 1635.9M	$ 1329.4M	$ 1018.3M	$ 693.7M	$ 353.4M	$ 0.0M	$ 0.0M	$ 0.0M
REINVESTED	$ 0.0M	$ 0.0M	$ 0.0M	$ 0.0M	$ 0.0M	$ 0.0M	$ 0.0M	$ 5.5M	$ 388.3M	$ 802.8M

COMPOSITE RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	-.018	0.121	0.185	0.228	0.261
UNIT PRICE	*****	0.046	0.185	0.252	0.297
UNIT VAR COST	0.261	0.228	0.185	0.122	-.014
TOTAL F.C.	0.223	0.205	0.185	0.161	0.133
FACILITIES COST	0.218	0.201	0.185	0.170	0.157

VITA

Andrew Louis Miller was born in Indianapolis, Indiana on April 19, 1948. He attended elementary schools in that city and was graduated from Southport High School in June of 1966. The following September he entered the University of Evansville, Evansville, Indiana, and in June of 1970 he received a Bachelor of Science in Business.

He was commissioned in January 1971 and served on active duty in the United States Air Force until December 1974. In January 1975 he began study at The University of Tennessee toward a Master of Science in Forestry, which he received in March 1979 with a major in Forestry. He is member of the Society of American Foresters.

Mr. Miller has been a Tennessee Air National Guardsman since December 1974. He is presently a Navigator/Operations and Plans Specialist for the Tennessee Air National Guard.