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Conventional Processing of Standard-Size Edge-Glued Blanks for Furniture and Cabinet Parts: a Feasibility Study

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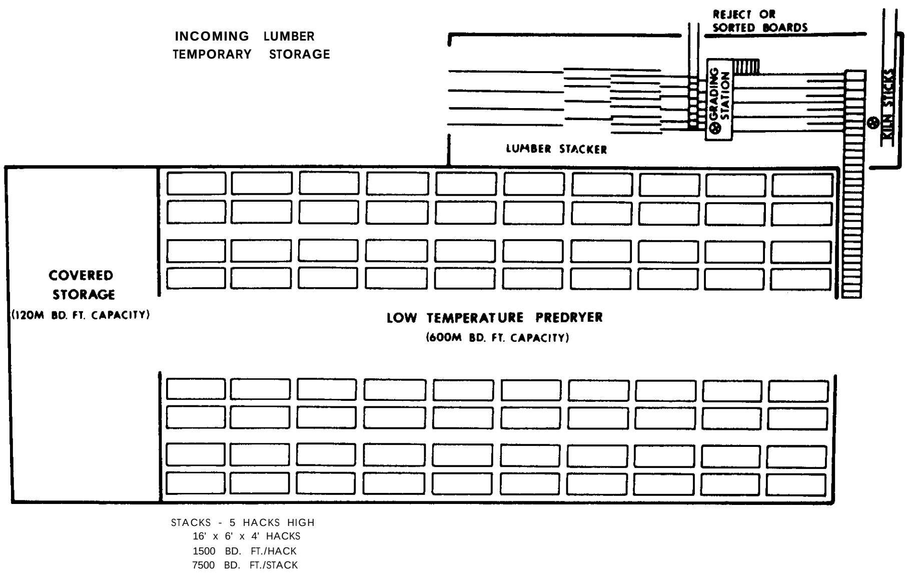

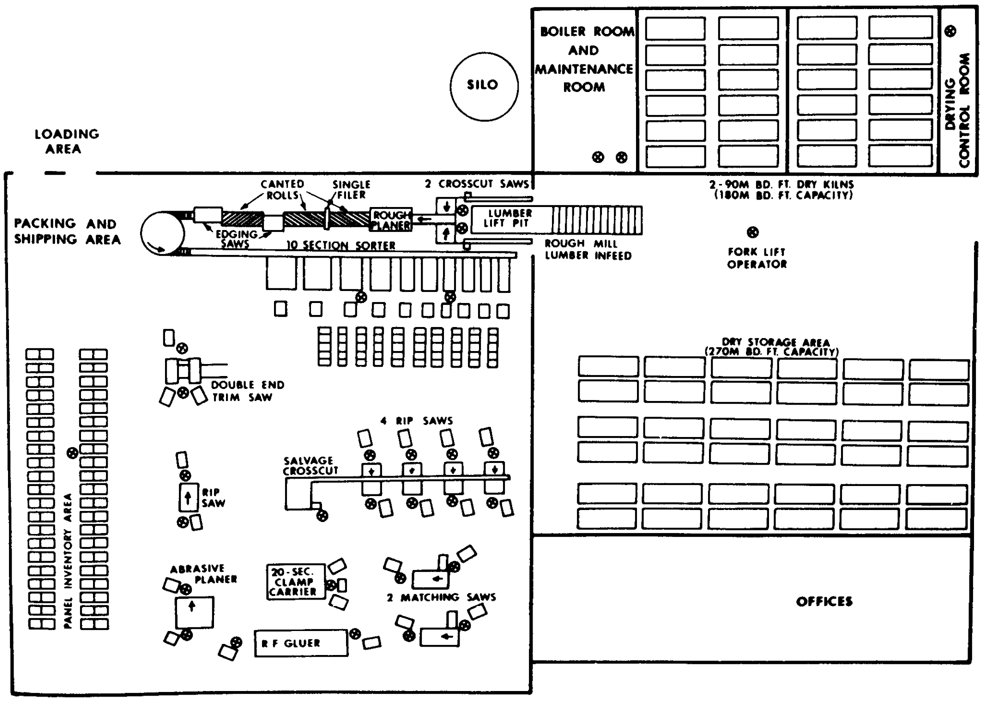

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Abstract

Manufacturers of furniture and cabinets use more than 2 billion board feet of hardwood lumber annually. As demand intensifies, we will need to utilize more of the abundant lower grade hardwood resource to assure future supplies at reasonable prices. Conventional processing of standard-size hardwood blanks manufactured from log-run red oak lumber, a resource containing over 40-percent low-grade No. 2 Common lumber, has been shown to be technically and economically feasible. Internal rates of return from 26 to 40 percent are possible when blanks are produced for outside sales or to replace open-market purchases of dimension. Accounting-based costs of producing 4/4 and 5/4 red oak blanks for internal consumption range from about $0.89 to $1.07 per square foot.

Introduction

In normal times, manufacturers of furniture and cabinets use more than 2 billion board feet of hardwood lumber, or about one-third of all hardwood lumber demanded, each year. Although the market for hardwood lumber currently reflects the overall economic downturn, once things improve the competition for our limited better grade resources will intensify. We will need to use more of the abundant lower grade hardwood resource to assure adequate supplies at reasonable prices.

A breakthrough toward this end was development of the standard-size blanks concept (Araman et al. 1982; Araman 1982), which focuses on the commonality in parts requirements among furniture and cabinet manufacturers. It was found that nearly all of the thousands of individual dimension part sizes used by the industry could be obtained from as few as a dozen sizes of blanks (wide edge-glued panels) in each required thickness. Conventional processing of low-grade lumber directly into rough dimension cuttings is considered difficult, if not impossible, by many. But making standard edge-glued blanks and processing them into rough dimension cuttings does hold promise because when the blanks are made:

- up to 12 standard lengths can be cut at one time with a longest-length-first cut-off technique,
- random-width cuttings can be edge-glued into wide blanks, and
- flexible inventories of blanks can be maintained and costly rough mill undercutting or overcutting problems can be eliminated.

To evaluate the potential of producing blanks from log-run lumber (No. 2 Common and Better), we simulated the operation of a modern, conventionally equipped plant to process 16 Mbf (thousand board feet) of lumber into 9.6 Mbf of edge-glued blanks per shift. In this report we will evaluate the economics of producing blanks for outside sales and for internal use within a parent company. In both situations we assume the production of 70 percent 4/4 and 30 percent 5/4 clear red oak blanks. For outside sales we assume that a totally new plant costing nearly $3 million will be required and that the blanks will sell for a weighted average price of $1.80 per square foot (90 percent of current dimension market values). These analyses focus upon calculation of the standard discount cash flow internal rate of return (IRR) and net present value (NPV) investment performance measures. For internal use, we based our analyses on accounting costs so as to facilitate more direct comparison with existing industry data. Since those contemplating a switch to blanks may make use of existing plant and equipment, we allowed for different amounts of capital investment in our analyses.

Our analyses indicate that investment in a new plant and equipment for open-market sales should result in an after-tax IRR of more than 26 percent if the plant is operated one shift per day. If it were operated two shifts, an IRR of almost 40 percent could be achieved. For those choosing internal use of the blanks, the cost per square foot of blanks manufactured ranges from $0.89 to $1.07 depending on the amount of new capital investment required and the level of operation. We believe that these costs are generally lower than those incurred by furniture manufacturers. As a result, conventional processing of standard-size blanks would seem to make economic sense regardless of whether they are produced for sale or for internal use.

Raw Materials and Product Yield

The raw material used to produce the standard-size blanks is assumed to consist of 70 percent 4/4 and 30 percent 5/4 green log-run red oak lumber purchased from local mills. We assume that the grade mix of this material is similar to that reported by Vaughan et al. (1966) for log-run upland red oak. If so, it contains 9 percent FAS (First and Seconds), 5 percent Select, 45 percent No. 1 Common, and 41 percent No. 2 Common. The lumber input cost of $293 per Mbf reflects a weighted average of the market prices for the different grades for both 4/4 and 5/4 red oak lumber as reported in Abe Lemsky's Hardwood Market Report (1981). A $40 delivery charge is added to each Mbf bringing the total input cost to $333 per Mbf.

Blank yields are estimated by combining the following:

- log-run grade mix,
- blank sizes and frequencies necessary to meet solid furniture dimension requirements (Table 1), and
- dimension yield tables found in Research Paper FPL-118 (Englerth and Schumann 1966).

Table 1.-4/4 clear quality standard sizes and estimated requirements for solid furnitures

Standard sizes L x W	Estimated requirements
Inches	%
15 X 26	6.3
18 X 26	9.7
21 X 26	9.8
25 X 26	9.8
29 X 26	9.7
33 X 26	10.4
38 X 26	9.9
45 X 26	13.3
50 X 26	2.7
60 X 26	7.2
75 X 26	6.5
100 X 26	4.7

[a]Based on data from Araman et al. (1982).

After 6 percent of the purchased input volume was deducted to account for shrinkage, the yield in blanks from the log-run lumber is 62.5 percent. To be conservative, we reduced this yield by 2.5 percentage points to 60 percent. This yield is possible partly because drying defects that normally reduce yield are minimized by predrying and then kiln drying, and by keeping the lumber protected at all times.

Processing System

The facility for producing hardwood blanks that we used in our economic analyses is illustrated in Figure 1. Although other designs are possible, ours relies on conventional techniques, including crosscutting first followed by random-width ripping. The plant site requires approximately 8 acres, and should be close to suppliers of hardwood lumber.

The mill operates 240 days per year, processing 16 Mbf of lumber into 9.6 Mbf of blanks per shift. One shift requires 3,840 Mbf of lumber annually; two shifts require 7,680 Mbf annually.

If operated on one shift, the mill employs a total of 38 people. Of these, five are classified as administrative and management. Production workers average $6 per hour, which includes a paid 2-week vacation. A second shift requires an additional management staff of two plus 29 additional production workers.

Lumber is purchased green, then graded, stacked, predried, kiln-dried, and stored for cut-up in the rough mill. Lumber is made into edge-glued panels by a conventional crosscut-rip-salvage rough mill. After edge gluing, blanks are rough planed and placed in inventory. Blanks are sold in standard sizes, but equipment is available to remanufacture the blanks to specific size parts if needed. Details of the major aspects of the production process follow.

Grading and Stacking

Incoming lumber is received and dead-piled near the lumber grading and stacking building. It is then graded and box-pile stacked automatically into hacks 16 feet long by 6 feet wide by 4 feet high, containing approximately 1,500 board feet each. Boards lower than No. 2 Common are not accepted and are stacked for the sawmiller to take back to his sawmill. Payment is based on the grade mix tally. Hacks are moved by forklift into the predrier.

Predrier

Predrier capacity is 600 Mbf of box-piled lumber. Each stack in the drier contains five 1,500-board-foot hacks. Lumber is continuously cycled through the drier. At 20-percent moisture content, the lumber is removed and placed in a covered temporary storage area before kiln drying. More than 9,000 Mbf can be processed annually, which provides excess capacity to allow for possible drying problems or delays. Average time in the predrier is 22 days.

Dry Kilns

Two 90 Mbf package dry kilns dry the lumber to 5- to 7-percent moisture content. These kilns have the capacity to dry more than 10,000 Mbf of lumber per year. Like the predrier, they provide excess capacity. Average time in the kilns is 6 days per charge.

Dry Storage

An area for dry storage and inventory for 270 Mbf of lumber is available. Here the lumber cools down after drying and is maintained at its new moisture content. Lumber stored here provides a buffer of raw material should one of the driers break down.

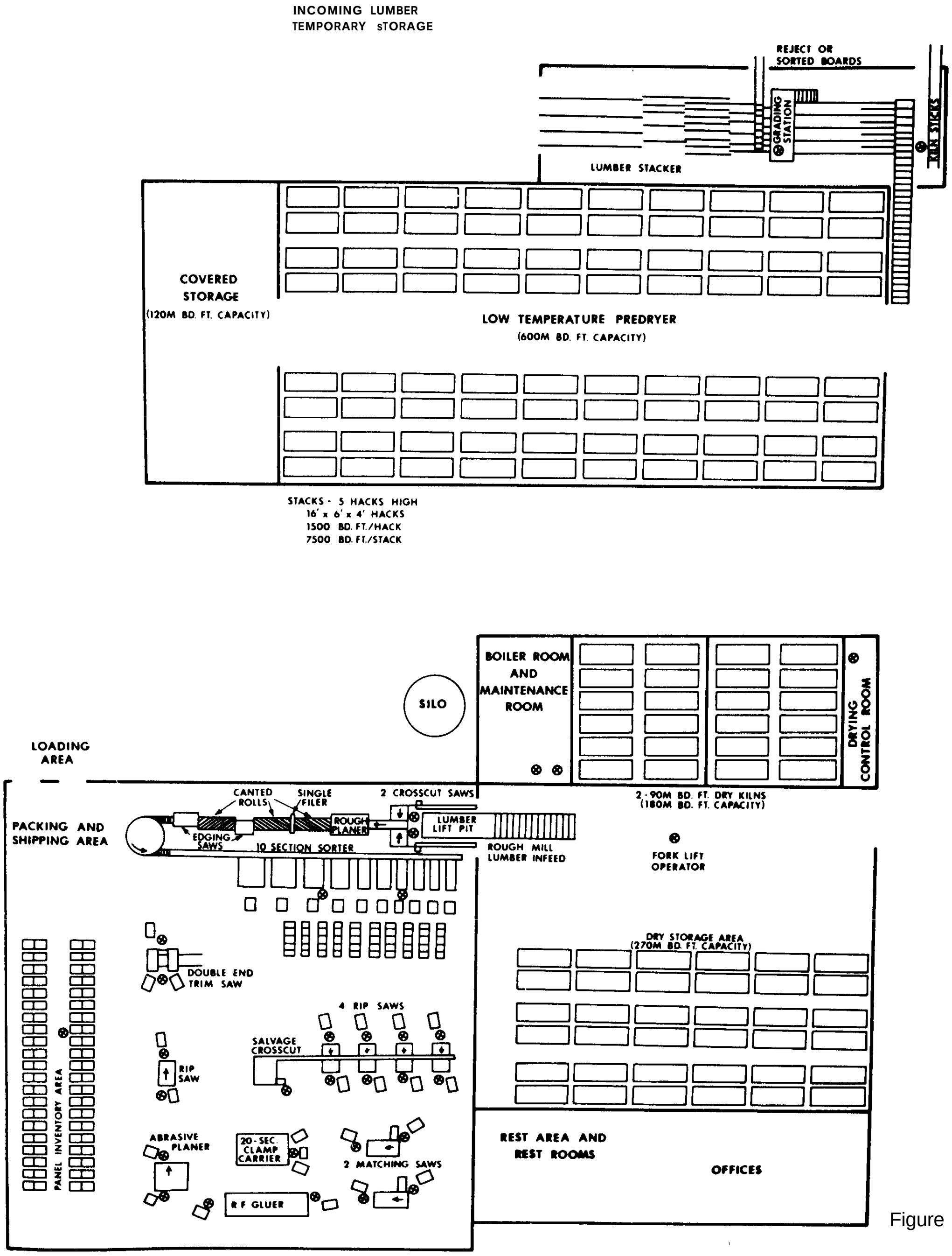


Figure 1.—Plant layout.

Rough Mill

The rough mill system can process 16 Mbf of lumber per shift into approximately 9.6 Mbf in standard-size edge-glued blanks. Hacks of lumber are rolled from the dry storage area into a lift pit in the rough mill. The lumber is then crosscut, the longest length obtainable first. Here lumber is cut into any of 12 standard lengths. Back gages are used only for the shortest three or four standard lengths. Cut-to-length boards are skip planed on two sides and automatically sent through two glue line edging saws. Boards are automatically sorted to length on a 10-section sorter and temporarily stored before ripping. Random-width cuttings are ripped from the cut-to-length boards. Pieces containing defects are salvage crosscut into shorter standard length cuttings. Clearcuttings are matched for color and grain into panel sets. Panel sets are cut to the standard blank width and edge-glued in the RF (radio frequency) gluer or the clamp carrier (either gluing system can be used). After a 24-hour period to allow for proper glue bonding, blanks are abrasive planed to 7/8 inch for 4/4 stock and 1-1/8 inches for 5/4 stock and placed in inventory on rolled conveyors.

Blanks Inventory

The inventory area is large enough for approximately 100 Mbf in blanks; an amount equivalent to the production of about ten 8-hour shifts. Inventories should be maintained to minimize the combined cost of stock-outs and holding. Actual inventory levels will depend on individual circumstances.

Filling Orders

Groups of standard-size blanks are strapped and wrapped for shipping. Specific rough dimension part orders can be filled by remanufacturing blanks into the required parts using a ripsaw and double end trimsaw located in this work area. These parts are also strapped and wrapped before shipping. Leftover edging strips from the ripping operation are recycled into the blank production at the matching saws.

Economics

Our analyses of the manufacture of hardwood blanks focus on the IRR and NPV discounted cash flow measures of investment performance. Such measures are preferred among financial analysts because they best account for the relationship among cash flows (that is, initial investment, operating cost, and revenues) throughout the life of the investment and explicitly recognize the timing of cash flows, foregone opportunities, and capital costs.

The information provided in these analyses should be of particular interest to potential investors in blanks, either for sale in the open market or to replace open-market purchases of dimension. In both instances, the price of blanks provides a good approximation of the returns (revenues, savings) that might be expected. Our assumption also provides a good approximation of the initial investment that would be required. We assume an initial investment of nearly $3 million in completely new plant and equipment (building and equipment requirements and cost estimates are found in the Appendix). Revenues are based on an average market price for blanks of $1.80 per square foot.

Open-market price and new investment assumptions may not be wholly appropriate for those furniture and cabinet manufacturers who currently produce their own dimension. The advantages blanks may hold for these investors include decreased costs; reduced production delays because of the ready availability of blanks in inventory; increased utilization of lower grade material; and consolidation of scattered rough-mill activities under one roof. Unfortunately, the economic advantages to this group are less easily identified through the IRR and NPV. First, open-market prices and internal costs are sometimes difficult to compare. Second, the initial investment required of these manufacturers is less if existing plant and equipment can be converted to the manufacture of blanks or sold. Recognizing these problems, we have developed an accounting-based cost summary that puts the information in a form comparable to existing accounting data maintained by the industry.

IRR and NPV Analyses: Data, Assumptions, and Results

Table 2 summarizes the cash flows expected during the 10-year investment in blanks manufacture for both the one- and two-shift levels of operation. Revenues and operating costs reflect a phasing-in period before full production is reached. For the single-shift operation, full production is not achieved until the second year. For the two-shift operation, full production is not achieved until the third year. More detail on how the operating costs and revenue were derived is found in Tables 3 through 6. The phasing-in of production is assumed so as to allow for training of the work force, development of the market, and other start-up adjustments that may be necessary.

Table 2.–Estimated cash flows (in thousands of dollars)

Year	Revenues	Operating costs	Depreciation [a]	Taxes [b]	After-tax [c] earnings
		One shift (full production in second year)			
1	1957	1347	329	129	481 [d]
2	3914	2230	492	548	1135
3	3914	2230	464	561	1122
4	3914	2230	435	574	1109
5	3914	2230	423	580	1104
6	3914	2230	83	736	947
7	3914	2230	71	742	942
8	3914	2230	71	742	942
9	3914	2230	71	742	942
10	3914	2230	60	747	937 [e]
		Two shifts (full production in third year)			
1	1957	1347	329	129	481 [d]
2	3914	2230	492	548	1135 [d]
3	7828	4231	464	1441	2156
4	7828	4231	435	1455	2143
5	7828	4231	423	1460	2137
6	7828	4231	83	1616	1981
7	7828	4231	71	1622	1975
8	7828	4231	71	1622	1975
9	7828	4231	71	1622	1975
10	7828	4231	60	1627	1970 [e]

[a] Depreciation is based on Accelerated Cost Recovery System percentages for property placed in service between 1981 and 1984.

[b] Income is taxed at 46 percent.

[c] After-tax earnings = after-tax profit + depreciation.

[d] Actual net cash flows will be less because of additions made to working capital.

[e] Actual net cash flows are larger because of a return of working capital and assumed sale of assets at book value.

Depreciation allowances have been calculated using the Accelerated Cost Recovery System schedules provided in the Economic Recovery Tax Act of 1981. With the exception of 40 factory trucks depreciated at 3 years, equipment is fully depreciated in 5 years. Buildings and permanent fixtures are depreciated over 15 years using the schedule for real property placed in service during the sixth month of the tax year. In keeping with standard practice, assets not fully depreciated in 10 years are assumed sold at the end of the 10th year at a price equal to their remaining undepreciated value. The proceeds of these assets, plus revenue from the sale of land and the return of working capital outlays are added to the after-tax cash flows in year 10.

Taxes were computed at the Federal corporate maxi mum rate of 46 percent. The investment tax credit, although available, was not considered.

The initial investment comprises land, building, equipment, and related expenditures of $2,911,610 plus $255,000 in working capital to cover first-year raw material, in-process, and finished goods inventories, and sales on account. Another $160,500 is added to working capital at the beginning of the second year to cover enlarged inventories required to accompany the move to full single-shift production. These additions are deducted from the after-tax cash flow in year 1. For the two-shift option, another addition of $368,500 is made to working capital at the beginning of year 3 to provide additional inventories to support the operation of two full shifts. This addition is obtained from the after-tax cash flow in year 2.

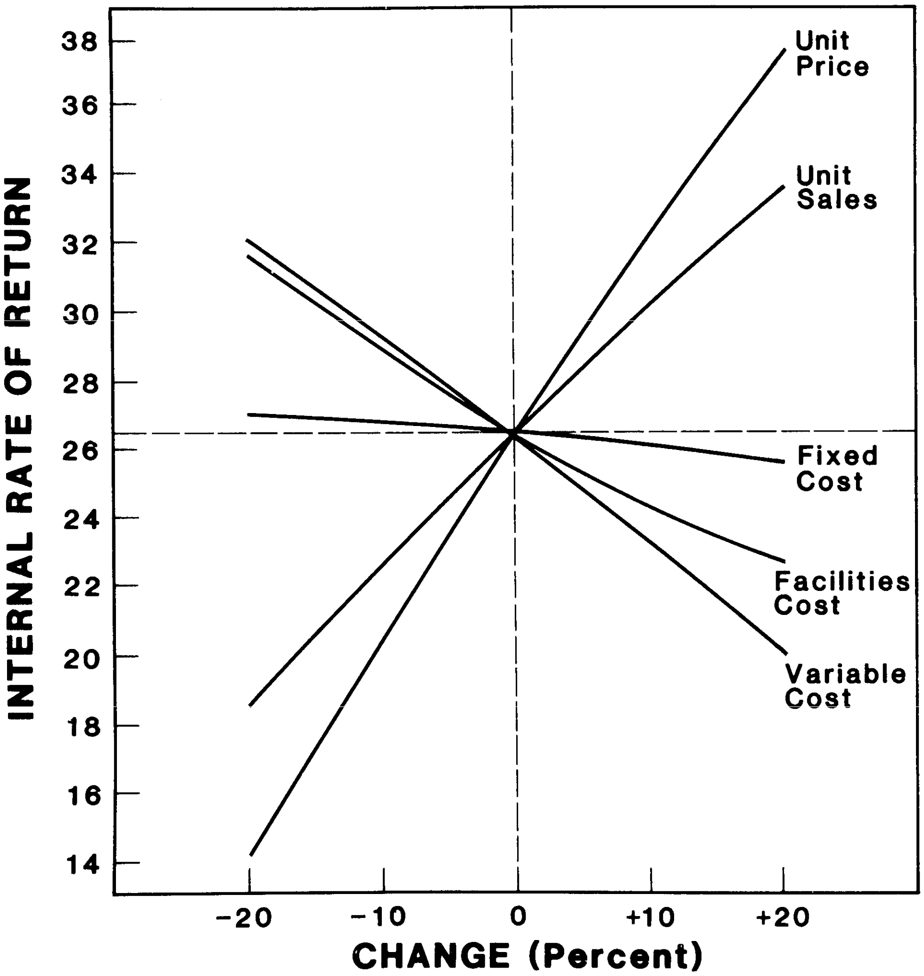
While individual investor circumstances, the cost of capital, and other investment opportunities will dictate ultimate investment decisions, it would seem from our analyses that manufacturing blanks is indeed worthy of consideration. The IRR of the one-shift operation was found to be 26.1 percent. The NPV for this same level of operation, given a 15 percent rate of discount, was $1,667,075. For the two-shift operation, the IRR was 39.8 percent; the NPV was $4,985,732.

In developing these measures, costs and revenues assumed during the 10-year period were held constant. This was done to eliminate the seemingly positive effect inflation assumptions can sometimes have on investment performance. It is realistic, in light of the history of the last decade, to expect inflationary increases. However, if misspecified, these increases can erroneously impact investment performance. For instance, had we assumed an 8-percent annual increase in both costs and revenues, the IRR for the single-shift operation would have increased to 31.8 percent; for the two-shift operation it would have increased to 46.3 percent. Under our conservative scenario of constant costs and revenues, actual performance will prove to be as good or better if inflation continues, except where costs increase at a significantly higher rate than revenues causing after-tax cash flows to decline.

The sensitivity of the IRR to changes in several investment parameters was analyzed using Harpole's cash flow analysis computer program (Harpole 1978). As can be seen in Figures 2 and 3, an increase in sales or price will increase the IRR while an increase in unit variable cost, total fixed cost, or facilities will decrease the I RR. Decreases in these factors will have a reverse effect.

The performance of both levels of operation, as measured by the IRR, is most sensitive to changes in the unit price of blanks. If the price of blanks were to drop by 10 percent from the price used in the original analysis, the IRR of the single-shift option would fall from 26.1 to 20.2 percent. A 20-percent price reduction would result in a 13.8 percent IRR, making the investment less than marginally attractive if weighed against our estimate of the cost of capital (15 percent). For the two-shift operation, the IRR would fall from 39.8 to 32.8 percent and 25.0 percent for a 10- and 20-percent drop in blank prices, respectively.

Figure 2.— IRR sensitivity to changes in selected investment parameters (single-shift operation).



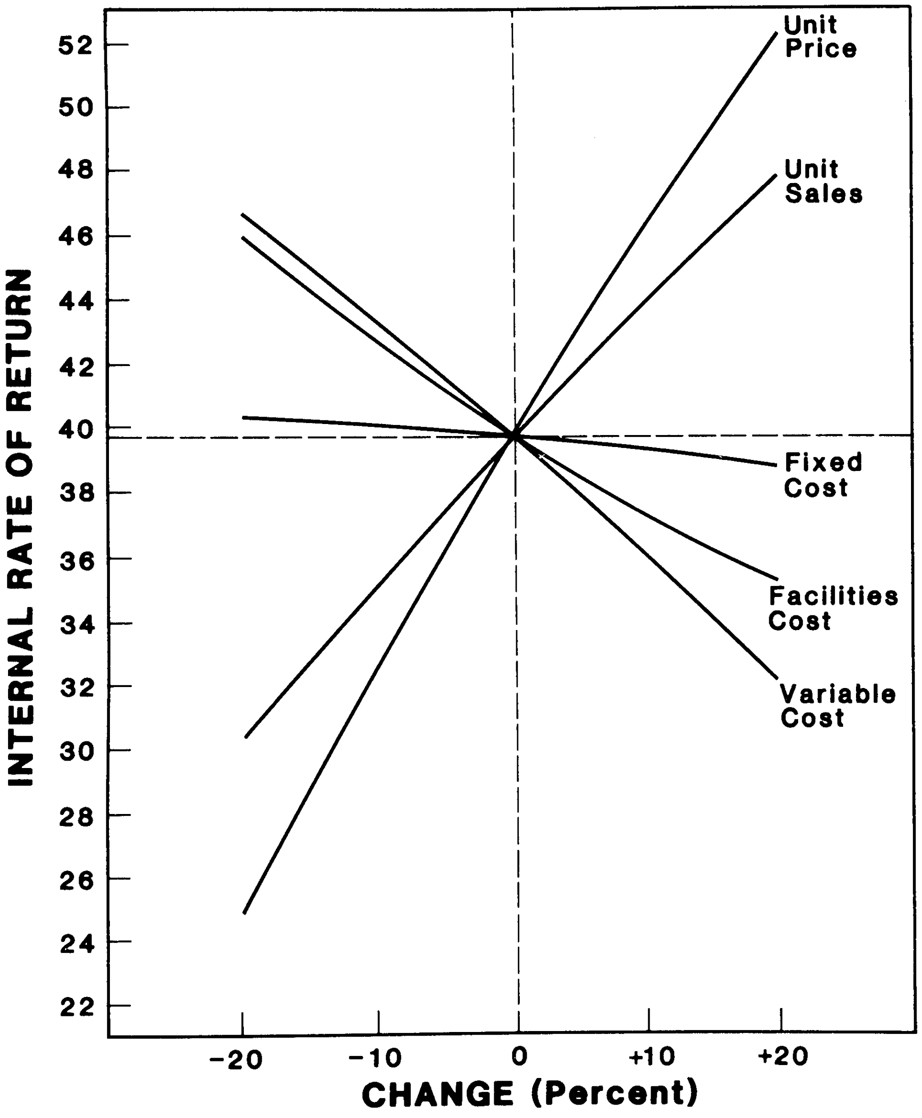
The investment is least affected by changes in total fixed costs. For both one- and two-shift alternatives, fixed cost increases of even 20 percent would reduce the IRR by less than 1 percentage point.

Accounting-Based Cost Analyses: Data, Assumptions, and Results

In developing accounting-based costs, we estimated the costs that would be incurred during a single year at full production for both the single and double shift operations. Except for the exclusion of selling expenses, the data for fixed and variable operating costs are basically the same as those found in Tables 3 and 5. Tables 4 and 6 show annual revenues for one-shift and two-shift operations.

Table 7 itemizes operating costs on a total and square-foot-of-output basis for both the one- and two-shift operations. As can be seen, total operating costs are equal to about $0.94 per square foot for the one-shift operation and about $0.89 per square foot for the two-shift operation.

Figure 3.— IRR sensitivity to changes in selected investment parameters (two-shift operation).



Investment in buildings and equipment is accounted for in Table 8. Comparison between the costs of plants established several years ago and those being contemplated today is not possible, however, unless some adjustment is made to either bring past costs in line with today's costs or to express today's costs in terms of yesterday's dollar. Therefore, to make comparisons possible, five levels of investment equal to O, 25, 50, 75, and 100 percent of that required for a complete new facility are provided for by depreciation computed on a 10-year straight-line basis. The five levels were developed for two reasons: First, building and equipment costs for existing manufacturers are estimated by depreciation of assets placed in service several years ago. Since the early to mid-1970's, the cost of these assets has about doubled. For instance, to equate current cost estimates with those for a dimension plant placed in service during the mid-1970's, the total cost estimate using a 50-percent capital investment would likely be most appropriate. Such costs are approximately $1.00 for the one-shift operation and $0.92 for the two-shift operation. For investments made during the latter 1970's, the category representing a 75-percent commitment is probably more fitting. For comparison with investments made before the early 1970's, a zero or 25-percent commitment assumption is likely to be most suitable.

The second reason for the five divisions in building and equipment depreciation is to allow, where possible, for conversion of existing plant and equipment to blanks manufacturing, and for the sale of existing plant and equipment that is no longer useful. Regardless of the situation, the amount of new investment required will be less than that required for a complete new facility. Where such reductions are possible, the data in Table 8 will provide an indication of costs based on actual expenditures.

Inclusion of depreciation based on an expenditure equal to that required for complete new facilities increases the cost per square foot for the single-shift operation by about $0.13 and for two shifts by about $0.065. Even with these additions, the total costs per square foot should be lower than the current costs of those who manufacture their own furniture dimension.

Table 3.—Annual operating expenses, one-shift operation

Item	Year 1	Years 2-10
Variable manufacturing costs:		
Lumber		
Red oak 4/4	$ 441,788	$ 883,575
Red oak 5/4	195,075	390,150
Supplies	30,000	50,000
Labor	297,000	396,000
Utilities	40,000	60,000
Selling expenses	97,850	195,700
Fixed costs:		
Management and administrative	130,000	130,000
Insurance	70,000	70,000
Maintenance	45,000	55,000
Total operating expenses	$1,346,713	$2,230,425

Table 4.—Annual revenues, one-shift operation

Item	Year 1	Years 2-10
4/4 blanks:		
Volume (ft^2)	806,400	1,612,800
Price/ft^2	$1.70	$1.70
Total revenue	$1,370,880	$2,741,760
5/4 blanks:		
Volume (ft^2)	276,480	552,960
Price/ft^2	$2.12	$2.12
Total revenue	$586,138	$1,172,275

Table 5.—Annual operating expenses, two-shift operation

Item	Year 1	Year 2	Years 3-10
Variable manufacturing costs:			
Lumber			
Red oak 4/4	$ 441,788	$ 883,575	$1,767,150
Red oak 5/4	195,075	390,150	780,300
Supplies	30,000	50,000	100,000
Labor			
First shift	297,000	396,000	396,000
Second shift	0	0	351,000
Utilities	40,000	60,000	100,000
Selling expenses	97,850	195,700	391,400
Fixed costs:			
Management and administrative	130,000	130,000	200,000
Insurance	70,000	70,000	70,000
Maintenance	45,000	55,000	75,000
Total operating expenses	$1,346,713	$2,230,425	$4,230,850

Table 6.—Annual revenues, two-shift operation

Item	Year 1	Year 2	Years 3-10
4/4 blanks:			
Volume (ft^2)	806,400	1,612,800	3,225,600
Price/ft^2	$1.70	$1.70	$1.70
Total revenue	$1,370,880	$2,741,760	$5,483,520
5/4 blanks:			
Volume (ft^2)	276,480	552,960	1,105,920
Price/ft^2	$2.12	$2.12	$2.12
Total revenue	$586,138	$1,172,275	$2,344,550

Table 7.—Operating cost summary for producing standard-size blanks for full production at one- and two-shift levels of operation

	One-shift costs		Two-shift costs	
Item	$	$/$ft^2$	$	$/$ft^2$
Variable manufacturing cost (less selling expenses)	1,779,725	0.822	3,494,450	0.807
Fixed manufacturing cost	255,000	.118	345,000	.080
Total operating cost (exclude depreciation on capital investment)	2,034,725	0.940	3,839,450	0.887

[a]Plant product mix—70 percent 4/4 red oak, 30-percent 5/4 red oak.

Table 8.—Total cost for producing standard-size blanks given different percentages of the capital investment depreciated on a straight-line basis over 10 years, in dollars per square foot of outputs

	Capital investment				
Item	0% $0	25% $705,403	50 % $1,410,805	75 % $2,116,208	100 % $2,821,610
			One-Shift		
Depreciation	0.0	0.033	0.065	0.098	0.130
Operating cost	.940	.940	.940	.940	.940
Total cost of production	0.940	0.973	1.005	1.038	1.070
			Two-Shift		
Depreciation	0.0	0.016	0.033	0.049	0.065
Operating cost	.887	.887	.887	.887	.887
Total cost of production	0.887	0.903	0.920	0.936	0.952

[a]Plant product mix—70 percent 4/4 red oak, 30 percent 5/4 red oak.
[b]Excludes land and sundry costs totaling $90,000.

Conclusion

The manufacture of standard-size blanks for open-market consumption is a new idea. It seems to have several important advantages that may strengthen its chances for success. First, it uses log-run lumber that contains upwards of 40 percent No. 2 Common—a grade traditionally eschewed by manufacturers of fine hardwood furniture and cabinets. Second, the process we have described is based on existing technologies. Third, because standard-size blanks can be held in inventory, a manufacturer of standard-size blanks would be able to respond in a flexible, timely manner to its own or its customer's demands. These attributes make standard-size blanks an attractive supplemental as well as primary source of solid wood material.

The sale of blanks at the prices and quantities specified will provide acceptable returns for both one-shift and two-shift operations. However, a full two-shift operation enjoys certain economies of scale and promises a substantially better return on investment and lower costs than the one-shift. It is also less susceptible to the adverse consequences of declining revenues or increasing costs. Thus once the operation is established, every attempt should be made to achieve a full two-shift level. For an independent producer of blanks, this will require a considerable marketing effort.

The manufacture of blanks by existing producers of furniture, cabinets, and other wood products seems to be even more promising. Their demand for blanks should be more predictable, as it would be derived from existing markets for the firm's products; production costs are comparable to or lower than present processing costs for dimension; and an external market for blanks might be developed to augment internal demand.

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Appendix

Estimated Building and Equipment Costs

Estimated building and equipment costs for the blanks plant as of October 1980:

1.	Land; 8 acres @ $10,000 per acre	$ 80,000
2.	Lumber stacking building (120 x 36 @ $8 per ft^2)	34,560
3.	Lumber stacker	165,000
4.	Predrier (600 Mbf capacity @ $0.50 per bd ft capacity)	300,000
5.	Covered storage area (40 x 90 @ $10 per ft^2)	36,000
6.	Dry kilns (two 90 Mbf capacity @ $2.25 per bd ft capacity)	405,000
7.	Dry storage area (100 x 122 @ $14 per ft^2)	170,800
8.	One forklift (22,500-pound diesel)	60,000
9.	Boiler room building ($14 per ft^2, boiler 250 hp, one 90-ton silo)	250,000
10.	Main building 145 x 145 (pre-engineered superstructure building @ $14 per ft^2)	294,350
11.	Rough mill system (handling equipment, sorter, etc.) plus scrap handling system	140,000
12.	Two crosscut saws	17,000
13.	Rough planer	50,000
14.	Two edging saws	40,000
15.	Five ripsaws	75,000
16.	Four guide lights	4,000
17.	One salvage chopsaw	2,500
18.	Roll conveyors ($10 per linear foot per section)	1,000
19.	Two single arbor matching saws	34,000
20.	One 40-section clamp carrier, 8 feet wide, with six 6-inch-wide clamps per section	30,000
21.	One RF gluer	35,000
22.	Abrasive planer (37-inch top and bottom machines)	55,000
23.	Roll conveyors (inventory area)	4,000
24.	Forty factory trucks ($335 each)	13,400
25.	Double end trimsaw	25,000
26.	Chipping hog	30,000
27.	Dust system	50,000
28.	Bag house	40,000
29.	Compressed air system (screw type 100 hp)	35,000
30.	Electrical installation, complete	125,000
31.	Plumbing installation, complete	50,000
32.	Heating system with humidity control	100,000
33.	Fire protect ion system	50,000
34.	Office space (4,000 ft^2 @ $20 per ft^2 for everything except furnishings)	80,000
35.	Office furnishings	20,000
36.	Sundry items (permits, tax, stamps, etc.)	10,000
	Total	$2,911,610

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Araman, Philip A.; Hansen, Bruce G. Conventional processing of standard-size edge-glued blanks for furniture and cabinet parts: a feasibility study. Res. Pap. NE-524. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1983.11 p.

Each year the manufacturers of furniture and cabinets use over 2 billion board feet of hardwood lumber. As demand intensifies, we will need to utilize more of the abundant lower grade hardwood resource to assure future supplies at reasonable prices. Conventional processing of standard-size hardwood blanks manufactured from log-run red oak lumber, a resource containing over 40-percent low-grade No. 2 Common lumber, has been shown to be technically and economically feasible. internal rates of return from 26 to 40 percent are possible when blanks are produced for outside sales or replace open-market purchases of dimension. Accounting-based costs of producing 4/4 and 5/4 red oak blanks for internal consumption range from about $0.89 to $1.07 per square foot.

ODC 671,836.1

Keywords: Hardwood dimension; hardwood lumber, log-run lumber; panels; economic evaluation; internal rates of return

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories are maintained at:

- **Amherst, Massachusetts, in cooperation with the University of Massachusetts.**
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