AN EVALUATION OF ASPEN PLYWOOD AND ITS MARKET POTENTIAL IN THE KITCHEN CABINET INDUSTRY

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ABSTRACT

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by Walter S. Good

Aspen is the most abundant species in Michigan but present utilization levels are far below the allowable cut for the species. The manufacture of veneer and plywood is one possibility for increasing this utilization and enabling the state to make more efficient use of its forest resource.

The demand for hardwood plywood has been steadily increasing since 1950 and this growth is expected to continue. Aspen can obtain a place in this hardwood plywood market if a steady supply of suitable quality can be assured.

This study investigated the present size of the hardwood plywood market with consideration of the relative positions of domestic hardwood plywood manufacturers and imports from other areas, considered the

technical problems involved in the manufacture of aspen into veneer and plywood and looked at the present state of the aspen plywood industry in both the United States and Canada.

A telephone and personal interview market study was conducted among kitchen cabinet manufacturers in Illinois, Indiana and Michigan to determine the potential market in this industry for aspen plywood. Conclusions were drawn regarding the end use areas, product specifications, price, promotional methods and distribution channels to be followed if aspen is to obtain a competitive market share in this area.

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INTRODUCTION

Purpose:

Since the early 1950's United States imports of hardwood plywood have increased from 0.2 to 1.9 billion square feet, surface measure. (46)(49) At present they represent over 52 percent of total U. S. consumption.

The purpose of this study is to investigate the trends and reasons behind this tremendous expansion in imports during this period, ascertain the effect of this expansion on domestic hardwood plywood production and offer some possible developments for the future.

Aspen* has been selected for case study. It is a species which has been little utilized for plywood but could be of increasing importance, especially to Michigan and the Lake States. With the quantity and quality of the preferred hardwood plywood species** decreasing, technological advances have been in the area of utilization of smaller logs of lower quality. (41) Aspen can be used with these advances to provide a substitute for other domestic species.

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* Scientific Nomenclature,See Appendix 1

** Birch, Gum, Maple, Oak, Walnut

Aspen stumpage is available in considerable quantities in both the United States and Canada and plywood manufactured from this species provides excellent possibilities as an import to the United States market or as a means of expansion for the domestic hardwood plywood industry. Both of these possibilities will be considered relative to future markets. This study will also include information regarding aspen plywood, its production and general uses.

Scope:

The material in this study covers several areas. Part II concerns the United States hardwood plywood market. Hardwood plywood is briefly described with reference to its construction, properties and applications. Total U. S. consumption of hardwood plywood includes a considerable volume of imports as well as domestic production. Both segments are considered with special attention to recent trends and developments and their present status in the market place. Indications of future trends in the hardwood plywood market are also included.

Parts III, IV, V, and VI are concerned with a case study of aspen plywood. The technical considerations involved in the manufacture of this species into plywood and the present state of the Canadian and American industries are examined. Michigan is considered as a possible site for the establishment of a domestic industry. The raw material supply and the present plywood industry in the state are both examined in view of locating a manufacturing unit. A market study of the potential for aspen plywood in the Midwest kitchen cabinet industry is also included in this section.

Part VII contains the author's summary and conclusions regarding the potential market for aspen plywood and the feasibility of establishing a manufacturing unit in Michigan.

Methodology:

Several sources of information were utilized to compile data for this study. They include:

1) Technical, promotional and statistical literature and reports of various individuals, associations, and government agencies.

2) A mail survey of 45 hardwood plywood manufacturers selected from the directory of the Hardwood Plywood Manufacturers Association (25) and the Canadian Poplar Plywood Association. They are located in both Canada and the United States, primarily in the Lake States. The survey was designed to obtain information regarding the present state of the aspen plywood industry and to obtain a statistical breakdown of present production.

3) A telephone and personal interview survey with kitchen cabinet and fixture manufacturers in the Midwest, namely Michigan, Indiana and Illinois. No statistical sampling technique was used in selecting the firms interviewed, but rather an attempt was made to select firms representative of the entire industry from small custom shops to large mass pro-

duction operations selling nationally in the consumer market. A telephone and personal interview technique was used in favor of mailed returns, because it was felt that the information received would be more accurate and complete as well as permitting open end questioning and further discussion in some areas.

4. Interviews with individuals involved in the production of aspen plywood, distributors of hardwood plywood products and government and association officials.

Limitations:

At present, the quantity of aspen plywood produced and consumed by U. S. manufacturing industries is negligble. This is the major limitation of the study. No mill in Michigan or the other Lake States is currently manufacturing aspen plywood for sale to industrial consumers. Because of this the author has assumed that any current market for aspen plywood in the kitchen cabinet industry would have to be met by imports from Canada. This potential market has been determined from the author's experience and end use applications found among Eastern Canadian kitchen cabinet manufacturers.

A limitation, with respect to the interviews, is the small number, approximately 40. The ideal situation would have included all kitchen manufacturers in the study area, but this would have been impractical due to the limitation on time and funds. However, the author feels that this shortcoming was somewhat offset by covering the range of manufacturers available in several geographic locations.

Confining the market study to the kitchen cabinet industry also constitutes a limitation. The bulk of the production from any aspen plywood mill would be in sheathing

and construction grades, but the author makes no attempt to analyze this market in the United States. Industrial grades are generally more profitable so this market sector would be of greater interest to Canadian manufacturers.

The kitchen cabinet industry is not the only potential industrial consumer of aspen plywood. It was selected because the product has obtained considerable acceptance among Canadian manufacturers in this classification. Manufacturers of case goods, commercial and institutional furniture, millwork and wall panelling represent other possible market areas, but the study of the entire industrial and wood-using market is too broad a scope for a study of this sort.

PART II - THE HARDWOOD PLYWOOD INDUSTRY

Hardwood Plywood:

Plywood consists of panels or other assemblies that are usually made up of layers of wood veneer bound together by an adhesive. Generally the panel is constructed of an odd number of plies, with the grain of any one ply running at right angles to that of adjacent plies. Some of the thicker plywoods (5/8 inch or over) may consist of a lumber or particleboard core placed between outer layers of veneer. Plywood panels are manufactured in various types and grades, depending primarily on their suitability for particular uses. Type and grades vary according to the core construction, the species of wood used in the face veneer, thickness, size of panels, appearance and type of adhesive used.

Plywood may be either softwood or hardwood. These terms, "softwood" and "hardwood", relate primarily to the botanical classification of the species of tree from which a particular wood is derived. "Hardwood" is a general term used to designate lumber produced from broad-leaved or deciduous trees, in contrast with softwood produced from evergreen

or coniferous trees rather than pertaining directly to the density or hardness of the wood itself.

Plywood is identified in the trade according to the species of wood used in the exposed surface (face) of the panel; for example, walnut plywood, birch plywood, gum plywood, etc. The principal hardwood plywoods manufactured from domestically grown trees are gum (red and black), birch, oak, (red and white), maple, walnut, ash, beech, cherry, elm, magnolia, and sycamore. Plywood is also manufactured domestically from several imported species, principally birch, mahogany and lauan. In recent years plywood of gum and birch have accounted for one-half to two-thirds of the domestic hardwood plywood output. A wide variety of hardwood plywood is imported, the principal ones being birch, lauan, oak, beech and mahogany.

Hardwood plywood is generally accepted in the furniture, cabinet, door manufacturing and wall paneling industries. It affords qualities of durability and attractiveness not generally obtained as economically by the use of other wood products. Plywoods have wide decorative potentialities resulting from the available grain, shades and figure patterns of the face veneers. There is a high degree of substitutability between plywood of the various hardwood species.

The hardwood plywood produced in the United States may be classified into two fairly distinct categories:

1. Container and packaging plywood
2. Hardwood plywood other than container and packaging

Container plywood is produced for a wide variety of containers and boxes for shipping, storage and dispensing. It does not have to meet the quality standards as to appearance, smoothness and the absence of defects generally required in the non-container types. There is little or no competition between container plywood and other hardwood plywood.

In recent years container plywood has accounted for less than one-tenth of the entire domestic production of hardwood plywood.(6) Manufacturers of container plywood tend to be smaller firms utilizing low quality material who produce container plywood exclusively. They may be considered to constitute a separate industry from those engaged in the production of non-container types. Little or no container plywood is imported. As a result there is no question of any competitive impact of imports upon this domestic industry. Accordingly, the remainder of this section will be concerned exclusively with the domes-

tic industry which produces hardwood plywood other than container and packaging types and the term "ordinary hardwood plywood" will be employed to designate all grades and types of hardwood plywood other than container and packaging plywood.

United States Industry:

In 1963, some 300 domestic mills were engaged in producing ordinary hardwood plywood and veneer. (5) These mills employed approximately 29,000 people with an annual payroll of over 96 million dollars. The number of employees per plant averages almost 100 with a few plants employing fewer than 25 employees and others as many as 500.

At present, most of the domestic plants are located east of the Mississippi River. A third of them are located in the South Atlantic states and produce the bulk of the gum plywood. The Lake States rank second, having more than a fourth of the mills. The Pacific Coast area has shown the most rapid growth in recent years and could account for the bulk of production in the future. (4) Of all the domestic firms, most are relatively small as almost three-quarters of them each produce less than five million square feet annually. This group accounts for only 30 percent of total United States output. On the other hand, the seven largest mills produce 16 percent of total output. The concentration is even more marked when viewed from the standpoint of the operating firms, rather

than the individual plants, since certain larger firms operate more than one plant, and such plants are generally considerably larger than the average domestic plywood plant.

Marketing and Distribution:

Domestically produced hardwood plywood reaches the ultimate consumer through varied channels of distribution. No clear-cut pattern characterizes the marketing practices of the bulk of the producers. A few firms sell most of their output to independent wholesale distributors; some sell predominantly to wood-using industries and industrial accounts; some maintain their own facilities for warehousing and distributing at the wholesale level. However, most sell to both wholesale distributors and industrial users.

To a great extent, the kinds of plywood produced by the firm often govern the channels of distribution. For example, standard size* panels generally find their best outlet at the wholesale-distributor level, whereas dimension or special-size plywood is sold almost exclusively to industrial users.

Domestic plywood manufacturers usually produce pri-

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* predominantly 4' x 8'

marily either for order or for the manufacturer's own use. Very little ordinary plywood is produced for inventory.

Manufacturers of ordinary hardwood plywood are identified as producers of either "market" or "captive" plywood. Plywood produced in plants which dispose of the product predominantly or exclusively by selling it in established distribution channels has been designated "market" plywood. In recent years, plywood marketed in this fashion has accounted for about two-thirds of U. S. consumption from about 150 mills. (50)

On the other hand, numerous firms, manufacturing such products as furniture, flush doors, and cabinets, find it to their advantage to produce all, or a good share, of their own plywood requirements. This production has been designated "captive" plywood and the bulk of it is produced in plants completely integrated with other manufacturing operations. In terms of annual output the average "captive" plant is considerably smaller than the average "market" plant.

Although a number of mills produce both "market" and "captive" plywood, most of the hardwood plywood mills market their output exclusively in one of these two ways.

TABLE 1 -- Veneer core hardwood plywood (except container and packaging type) production by face species 1961-64 (quantity figures in thousand square feet, surface measure)

Species of Face Ply	Production for all purposes (Quantity)			
	1964	1963	1962	1961
Birch	615,447	555,096	469,675	362,996
Gum	241,842	252,758	270,167	274,638
Maple	66,263	60,876	61,538	43,274
Oak	165,900	157,082	163,633	156,618
Walnut	126,151	110,995	98,873	87,246
Other Domestic	174,032	131,665	125,707	111,169
Mahogany	18,410	23,612	26,124	26,003
Philippine Woods	301,065	234,717	197,469	183,145
Other Imported	80,811	75,251	55,075	50,983
TOTAL: All Species	1,789,921	1,602,052	1,468,261	1,296,072

Source: U. S. Department of Commerce, Bureau of the Census, 1961-64 (6) (7)

The production of hardwood plywood increased substantially every year from the end of World War II until the early 1950's. Production increased from 675 million square feet in 1944 to almost double that amount in 1953.(49) The industry suffered some setbacks and slight decreases for the next several years and production did not attain the 1953 level again until the sixties. This was due primarily to a slight recession that occurred during this period, a sudden increase in the volume of imports and a decline in the quality of material available to domestic manufacturers. Since 1960 the industry has advanced steadily at a rate of 10 - 15 percent annually. The output for 1964 of almost 1.8 billion square feet (Table 1) was surpassed in 1965 when 1.9 billion square feet of ordinary hardwood plywood was produced. (32)

TABLE 2 -- Veneer core hardwood plywood (except container and packaging types) production by face species as percent of total 1954 and 1964

	Percent of Total Production	
Species of Face Ply	1954	1964
Birch	20	30
Gum	37	12
Maple	4	3
Oak	9	8
Walnut	4	9
Other Domestic	9	13
Mahogany	11	1
Philippine Woods	4	21
Other Imported	2	3
TOTAL	100	100

Source: U. S. Department of Commerce, Bureau of the Census, 1954 and 1964 (6)(49)

A marked change in the species composition of the hardwood plywood production has occurred in the last decade. Gum represented almost 40 percent of total production in 1954 but had fallen to only 12 percent by 1964 (Table 2). Birch and lauan showed the greatest growth both in percentage of total production and quantity of plywood produced. These trends have been evident for the last several years and should continue at least at present levels because of increased importing of these species in the log or flitch form for manufacture into veneer and plywood by domestic mills.

Import-Export Trade:

United States exports of hardwood plywood in 1964 amounted to less than 3 million square feet, surface measure, (22) or less than one-fifth of one percent of total domestic production for that year. This quantity can be considered insignificant so the remainder of this section will deal exclusively with imports into the United States.

The United States Tariff Act of 1930 did not provide separately for hardwood plywood as such. Under the Act, most plywoods, whether having a face ply of hardwood or softwood veneer, were dutiable at 40 percent ad valorem. However, plywoods of birch or alder, both of which are hardwood plywoods, were dutiable at 50 percent ad valorem. (Table 3)

In trade agreements negotiated since then, various duty concessions respecting plywood have been made. Birch and alder are the hardwood plywoods on which duty concessions have been separately negotiated. A concession has also been granted on "other" plywood or all other plywood that has not been separately identified by species. The concession on "other" plywood, however, specifically excluded Spanish cedar plywood (a hardwood plywood); hence,

it is now separately identified.

TABLE 3 -- United States rates of duty on hardwood plywood under the Tariff Act of 1930, in specified years 1930 to 1960 (Percent ad valorem)

Item	Tariff Rate		
	1930	1945	1960
Birch	50	25[1]	15[2]
Alder	50	50	25[3]
Spanish Cedar	40	40	40
Other	40	40	20[2]

[1] Trade agreement with Finland, effective November 1936.

[2] General Agreement on Tariffs and Trade (Torquay), effective June 1951.

[3] General Agreement on Tariffs and Trade (Annecy), effective April 1950.

Sources: U. S. Tariff Commission 1955 (49)

After World War II, Canada, Japan, and Finland were the leading countries of origin of United States imports of hardwood plywood. (49) During the period 1947-52, Canada supplied from 80 to 90 percent of the total. In 1953, a marked increase in entries from Japan placed that country ahead of Canada as the leading source with 105 million square feet. Japanese imports increased tremendously during the next several years to a level of over 800 million square feet in 1959, a figure which represented approximately 60 percent of the total imports in that year. (Table 4) Since that time imports from Japan appear to have levelled off around 700 million square feet and should remain at approximately that level as more and more of their production is required to meet increasing domestic demand.

Imports from the Philippines have also shown a marked increase since the late 1950's having increased from 33 million square feet in 1957 to over 300 million square feet in 1965. Taiwan and Korea have become major factors in the imported plywood picture in the last couple of years. Their exports to the United States have increased from insignificant amounts in 1960 to 337 million square feet for Korea and 469 million square feet for Taiwan in 1965. Im-

TABLE 4 -- United States imports of hardwood plywood by country of origin, 1950-65 (million square feet, surface measure)

Year	Total	Canada	Latin America			
			Total	Mexico	Central America & West Indies	South America
1950	63.3	50.0	6.3	0.8	---	5.5
1951	70.2	47.2	5.6	.7	0.1	4.8
1952	85.0	57.1	3.7	.9	.1	2.6
1953	220.4	50.8	8.6	2.1	1.9	4.5
1954	434.0	71.1	8.0	3.4	.2	4.4
1955	627.6	99.3	8.8	3.6	1.4	3.9
1956	706.5	81.2	5.3	.4	1.0	3.9
1957	846.4	64.4	9.2	1.8	1.9	5.6
1958	911.4	42.4	11.9	6.0	.6	5.3
1959	1330.2	60.2	32.1	8.6	4.4	19.1
1960	1014.0	43.0	13.8	2.5	1.8	9.5
1961	1097.4	42.1	17.7	1.4	2.5	13.9
1962	1438.9	56.5	15.7	1.3	.7	13.7
1963	1620.7	71.9	18.8	1.2	1.2	16.4
1964	1947.2	68.1	13.7	.2	2.2	11.3
1965	2137.1	64.6	8.6	2.6	2.7	3.3

[1] Includes 469 million square feet from Taiwan and 337 million square feet from Korea.

[2] Includes 103 million square feet from Finland.

Source: U. S. Department of Commerce, 1950-65 (22,46,47)

TABLE 4 -- Continued

Asia				Africa	Europe	Other
Total	Japan	Philip-pines	Other Asia			
5.4	5.1	0.3	---	---	1.5	---
13.1	12.9	.1	0.1	0.4	3.8	---
17.6	17.3	.1	.1	.6	6.0	---
106.3	105.0	.5	.8	3.6	51.0	---
291.8	289.0	1.2	1.2	5.3	51.7	6.2
439.2	428.6	9.8	.8	10.9	62.5	6.9
543.5	527.2	14.9	1.4	13.8	53.4	9.3
717.6	679.8	33.2	4.6	11.0	40.4	3.9
794.3	669.9	97.4	27.3	15.6	46.3	.9
1083.0	810.9	213.6	58.5	25.8	125.1	4.0
857.1	688.3	118.8	50.0	16.7	83.2	.2
962.0	660.5	153.4	148.2	14.6	58.6	2.4
1268.8	740.3	214.4	314.1	13.8	83.7	.4
1428.4	739.8	246.7	442.0	9.1	92.5	---
1747.2	680.5	355.7	711.0[1]	9.3	108.8	---
1939.1	768.3	308.1	862.7[1]	6.8	117.5[2]	3.1

ports from Asian countries currently represent 90 percent of the total United States imports of hardwood plywood.

Finland is the major European exporter of hardwood plywood to the United States. Its total of 103 million square feet ranks fifth in importance in the imported hardwood plywood market.

Table 5 illustrates dramatically the shift that has occurred in the producing area for hardwood plywood imported into the United States during the last 15 years. The quantity of plywood imported has increased tremendously in the interim, from 63 million square feet to 2,130 million square feet, and this production has come almost entirely from Asiatic countries. Canada produced 80 percent of U. S. imports in 1950 but now accounts for only three percent even though the volume in square feet has remained reasonably constant. Japan, Taiwan, the Philippines and Korea were of almost no importance in 1950 but now account for 88 percent of the present volume. The U. S. is now very dependent on this region as a source of supply for its finished hardwood plywood as well as veneer logs which are manufactured into plywood by domestic mills.

TABLE 5 -- United States imports of hardwood plywood by country of origin, specified years 1950-65 (Percent of total imports)

Country of Origin	1950	1960	1965
Canada	80	4	3
Japan	8	68	36
Taiwan	--	4	22
Philippines	--	12	14
Korea	--	--	16
Finland	3	5	5
Other	9	7	4
TOTAL	100	100	100

Source: Table 4

Birch and lauan are the principal species of hardwood plywood imported. In 1965 these two types accounted for 88 percent of the total imports of hardwood plywood. (Table 6)

Lauan plywood constituted 75 percent of total 1965

TABLE 6 -- United States imports of hardwood plywood by major species, 1960-65 (million square feet, surface measure)

Major Species	1965	1964	1963	1962	1961	1960
Lauan	1610.6	1434.2	1167.6	1078.6	777.4	669.8
Birch	270.2	227.3	196.4	161.4	131.7	130.1
Sen	103.8	119.8	133.6	113.8	94.9	91.8
Other Hardwoods	146.0	165.4	122.5	85.2	93.4	123.1
TOTAL	2130.6	1946.6	1620.1	1439.0	1097.4	1014.8

Source: U. S. Department of Commerce 1960-65 (46) (47)

imports. It comes almost entirely from Japan, Taiwan, the Philippines and Korea with Japan and Taiwan each having approximately a 30 percent market share and the other two countries 20 percent each.

Birch plywood comes predominantly from Canada, Finland, and Japan. Nearly all the imports from Canada and Finland consist of birch. Finland is the largest supplier with 103 million square feet in 1965 or 40 percent of the total imported birch market. Canada and Japan share the remaining 60 percent equally.

Plywoods of other species have been imported in fairly substantial quantities in the last few years, including sen (Japanese Ash) from Japan, tropical American mahogany from Mexico and Central America, beech from European countries and various other species of temperate and tropical hardwoods.

The United States hardwood plywood industry generally does not seem to have been too badly hurt by the increasing volume of imports. Net profit to net sales ratios dropped for several years after the duty concessions of 1951 (49) but this was due primarily to temporary price stabilization caused by the lower priced imports while

the domestic industry was facing a situation of rising production costs. This may have forced the closing of some small, inefficient operations, but the majority of the mills survived the crisis until the increase in demand in the late fifties improved their profit picture. Today the industry is more successful than ever before and production figures have hit all time highs for the past several years.

Diversification has partially been the key to the growth of the domestic industry. Imports are almost entirely in unfinished, standard size panels of one-quarter inch or less in thickness. By offering increased services and secondary manufacturing like cutting-to-size as well as concentrating on various specialty fields, domestic producers have been able to dispose of their production and maintain reasonable profit levels. The two sources tend to supplement each other and the large available supply permits the use of plywood in areas which might otherwise have gone to competitive products. In 1965, 45 percent of all imported plywood went into the manufacture of flush doors while only six percent of domestic production went to this application. (32)(46) On the other hand, 25 percent of total domestic shipments in

1965 were represented by molded, curved or cut-to-size hardwood plywood, an area in which the quantities of imported plywood used are insignificant. Prefinished plywood panels have also been an area of considerable importance to domestic producers. Production has increased from 100 million to 1500 million square feet in the last 10 years. The field is still increasing very rapidly with improved finishes and technology. Eight new firms appeared in 1965 alone to capitalize on this growing market. (32)

Consumption and Uses:

As mentioned earlier in this section, almost no hardwood plywood is manufactured by domestic plants for inventory purposes and exports constitute a very insignificant percentage of total domestic production. Because of this, apparent domestic consumption can be assumed to be the sum of domestic production plus imports. As shown by Table 7, consumption has increased quite dramatically in the last several years.

Total consumption increased over 50 percent from 1961 to 1964 and this figure was three times as large as the consumption in 1952. In the early fifties, imports represented a very small proportion of total consumption but by 1963 over one-half of consumption was composed of imports.

This tremendous increase in demand or consumption during the sixties is being met predominantly by imports. Domestic production is increasing at a much lower rate because of a decreasing raw material supply and other factors, so this would seem to be a continuing trend for the future.

Various factors have contributed to this increased consumption. The volume of production of furniture and

TABLE 7 -- United States production, imports and apparent consumption of hardwood plywood, specified years 1951 - 64 (million square feet, surface measure)

Year	Domestic Production	Imports	Apparent Consumption	Percentage of Imports to Production	Percentage of Imports to Consumption
1951	1173	66	1239	5.6	5.3
1952	1176	85	1261	7.2	6.7
1953	1242	219	1461	17.6	14.9
1954	1093	425	1518	38.8	27.9
1961	1296	1097	2393	84.6	45.8
1962	1468	1439	2907	98.0	49.5
1963	1602	1621	3223	101.1	50.2
1964	1790	1947	3737	108.7	52.1

Source: U. S. Department of Commerce and Bureau of the Census 1951 - 64

fixtures has increased several fold since the early fifties and the style trend toward flat surfaces in furniture and interior finishing has increased the quantity of plywood used in these products. Another major development has been the large displacement of the traditional panel door by the flush door, in which hardwood plywood is customarily used. The production of flush doors has increased from approximately one million in 1950 (49) to almost 30 million in 1963. (5) In 1964, 44 percent of all imported plywood and six percent of domestic production went into the manufacture of flush doors. (47,6)

Projected demands for hardwood plywood are forecasted to be: (40)

1970	4.5 billion square feet
1980	6.0 billion square feet
1990	7.5 billion square feet
2000	9.0 billion square feet

Imports will continue to expand their market share and will eventually supply 60 - 70 percent of total consumption. (40)

Domestic producers will have to face a serious problem as much of this country's virgin timber is depleted. The industry will have to face an increasing scarcity of

quality wood as raw material. Log diameters and log quality have presently decreased to the point where many No. 1 lumber logs rather than peeler or veneer logs are being used for veneer and the average diameter seldom reaches above the 16 - 20 inch range. This scarcity will increase raw material costs, and therefore, consumer costs and open the door for competitive products to move in. As a result domestic mills will have to depend more and more on imported veneer logs, bolts and flitches to increase production beyond present levels.

PART III - ASPEN PLYWOOD

Manufacture:

Aspen (Populus tremuloides) is generally characterized by rapid growth, a short life, a height of 50 - 60 feet and a diameter of 1 - 2 feet. (42) Utilization of such a species for plywood requires special small-log equipment. Rotary cutting is the predominant cutting method of making veneer from aspen with lathes capable of turning to a core diameter of 3 inches and adaptable to cutting bolts as small as 8 inches in diameter. (17) Lathes of this sort are small, fast and relatively simple in design. Because of the relatively small volume of veneer obtained from a single bolt, it is not feasible to stop to make adjustments according to the characteristics of individual bolts. As the diameter decreases, changing the knife angle or "pitch" is generally not necessary because of the limited range of carriage movement. Similarly, variable rotational speed is relatively unimportant. At small diameters, any tendency of the bolt to bow due to nosebar pressures is counteracted with a back-up roll which rides against the log opposite the

pressure bar. The force exerted by the back-up roll can be adjusted to approximately balance the force exerted by the pressure bar. (41)

The lathe alone is not sufficient to make the veneering of aspen economically feasible, but it should be supplemented with high speed equipment for mechanized handling of bolts and veneer and radio frequency gluing equipment or contact adhesives for edge gluing pieces of veneer into larger sheets.

A large number of interrelated and interacting variables must be considered to manufacture aspen into veneer and each has an effect on the quality of veneer produced. The most important of these are: (15)

a) Veneer thickness
b) Angle of veneer knife
c) Horizontal opening between knife edge and pressure bar
d) Vertical opening between knife edge and pressure bar
e) Diameter of bolts
f) Temperature of bolts
g) Knife bevel

Aspen can readily be cut into veneer up to 1/20" thick, but beyond this limit problems are encountered with the veneer jamming between the pressure bar and knife and coming off in ribbons. This is owing to the tendency of the thin veneer to cut woolly and tear. (40) For veneer up to this 1/20" limit the optimum lathe settings are illustrated in Table 8.

TABLE 8 -- Optimum lathe settings for rotary cutting aspen veneer

Veneer Thickness	Knife Angle	Horizontal Opening of Pressure Bar	Vertical Opening of Pressure Bar
Inch	Degree-Minutes	Inch	Inch
1/20	90°- 30'	0.044	0.012
1/16	90°- 30'	0.057	0.015
1/8	90°- 0'	0.115	0.028

1. Knife bevel = 19°0'
2. Source: (15, 35, 42)

One of the characteristics of aspen veneer is the frequent formation on its surface of a wool composed of

an agglomeration of loose fibers. A very sharp knife is essential to smooth cutting in aspen, but even this will not completely eliminate the woolliness. Temperature appears to be a greater factor in this regard. Almost no wool is formed when the bolt is peeled at a temperature just above the freezing point, but the amount of wool increases appreciably as the temperature is increased above this temperature. If a bolt is cut while frozen, the veneer contains deep lathe checks extending through its entire thickness and is too delicate to be handled without tearing. Wool, however, is only loosely attached to the veneer and can be removed easily from the dried veneer by means of a light brushing. If the wool is allowed to remain on the veneer when the plywood panels are assembled, it will be pressed into the surface and leave tiny depressions in the faces. (14)(15)(35)

The drying of aspen veneer usually causes very little degrade. The green veneer is generally at greater than 100 percent moisture content, but a drying schedule similar to Table 9 will give good results.

TABLE 9 -- Drying schedules[1/] for Aspen veneer

Veneer Thickness	Dryer Temperature	Drying Time	Average Final Moisture Content
Inches	Degree F.	Minutes	Percent
1/20	320	6	2 - 4
1/16	320	8	2 - 4
1/8	320	16	2 - 4

[1/] Schedule for a mechanical roller-type veneer dryer

Source: U. S. Forest Products Laboratory (42)

Aspen veneer dries fairly flat with buckling only around areas of irregular grain or fuzziness. There has been some reports of collapse in areas of mineral streak, but this is a rare occurrance. (42) Occasional wet spots may be present in the dried veneer and cause a problem in bonding, but these can be eliminated with careful drying practices. (11)

The gluing properties of aspen are very good. Some instances of starved joints have been encountered, but they are easily overcome. Good quality glue bonds can be produced in aspen plywood with either a hot-press urea

resin glue or a hot-press phenol resin glue. (35) Tension shear specimens of both gluelines tested in the dry condition have given an average shear strength of approximately 380 p.s.i. and an average wood failure of 90 - 95 percent. (35) These results are considerably higher than required for low density hardwood plywood in both Canadian and U. S. A. standards. (10)(45)

The yield of veneer in aspen is generally in the range of 70 percent of the cubic volume of the bolt when peeling to small diameters. The waste, which comprises the remaining 30 percent of the bolt, is made up of:

Rounding waste 14 - 16%

Clipping and trim waste 6 - 7%

Core waste 7 - 9%

These figures are based on peeling, 48-inch bolts. If the bolts had been eight feet, the rounding waste would have been higher because of greater taper and crook.(9)(35)

The veneer grade yield is somewhat more variable and dependent on whether the bolts are specifically selected as peeler logs or randomly selected from a range of log grades. The present CSA Standard 0153-1963 for poplar plywood (10) includes four grades of aspen veneer. The following is an abridged description of the grades:

Grade A - One or more pieces of firm, smoothly cut veneer joined so as to avoid strong color contrast at the joint. Free of knots, holes, splits, rough grain and any form of decay.

Grade B - One or more pieces of smoothly cut veneer but not matched for color at the joints. Sound tight knots up to one inch diameter, slight discoloration, shim patches, and neatly made wood inlays permitted.

Grade BB - One or more pieces of veneer to present a solid surface free from open defects. Sound, tight, encased knots up to 1½ inches in diameter, rough grain and tapered splits up to ¼ inch in width if repaired with synthetic filler permitted.

Grade C - One or more pieces of veneer with sound, encased knots up to two inches in diameter, knot holes up to one inch in diameter and other defects which do not impair the serviceability of the panel.

A reasonable expectation of grade yields in 12 - 14 inch aspen bolts would be as follows: (15)(35)(42)

Grade A -- 4 - 7%

Grade B -- 37 - 45%

Grade BB - 20 - 25%

Grade C -- 30 - 45%

A yield of this sort is considered to be a very satisfactory distribution of quality for the production of ¼-inch 3-ply panels. Cutting to smaller core diameters increased total yield but decreased the percentage of better grades because of the greater number of knots near

the pith of the rotary-cut bolts.

Properties:

Aspen is a low density wood, its average weight per cubic foot at 15 percent moisture content is 27 pounds as compared to yellow birch (43 pounds) or Douglas fir (34 pounds).(44) One of its most important properties from the standpoint of its use for veneer and plywood is its uniformity of structure. Aspen is technically classed as a diffuse porous hardwood, indicating that the spring-wood-summerwood differentiation is generally not distinct. The annual rings do not form alternate bands of hard and soft tissue as found in ring porous hardwoods like oak and in coniferous woods like yellow pine and Douglas fir. Uniformity of wood structure is important in making veneer sheets, as it controls uniformity of physical properties. This is particularly true in rotary-cut veneer, where the cutting direction more or less parallels the annual rings. Uniformity of structure produces veneer of equal density throughout and eliminates variations in strength and stability of both veneer and plywood. The uniform wood structure of aspen is common to such valued veneer woods as birch, maple, basswood and mahogany. (17)

The low density of aspen is an advantage in core veneer

for plywood panels. (15) Since the bending strength of a plywood panel depends primarily upon the strength of the surface plies, the core plies (crossbands) for most uses, need not be as dense and strong. (44) In thin plywood panels, cores of comparatively low density and strength are advantageous in maintaining stability. A low density core tends to minimize internal shrinking stresses in these cross-banded structures. (17) Basswood has long been valued as a core veneer, and aspen has similar properties with the added advantage of superiority in shrinkage characteristics. (9)

Aspen has a light color and lack of grain as well as paint and enamel holding properties superior to most other veneer woods. (15)(17)(42) It will take white and tints with ease, and there is no danger of raised grain showing through or of pitch troubles.

The cutting characteristics of aspen are very good. It is very similar to basswood in rotary cutting and can be cut successfully without heating the bolts.

The gluing properties of aspen are excellent. (35) It is classed with those woods "that glue easily with different glues under a wide range of gluing conditions." (44) This makes it well adapted to edge gluing and end

joining. Thin panels of veneer or plywood can be readily glued to cleats or framing members. (17)

Uses:

Aspen has high technical qualities in the clear wood, yet it has a relatively high percentage of natural defects in veneer logs. (17) For this reason the one operation must produce a variety of plywood grades suitable for a number of end uses.

Low grades of aspen plywood with the appropriate type of glue bond are suitable for sheathing, underlayment, other general construction purposes and shipping containers. (15) It is lightweight, resistant to splitting, smooth wearing, odorless and has a light color. These properties make it very suitable for these applications.

The better grades can find widespread application as general purpose plywood or plywood that requires neither the density and finishing characteristics of birch nor the structural strength of Douglas fir. There are many uses for which aspen would be adequate such as signs, painted and unpainted furniture, display fixtures, household cabinets, drawer sides and bottoms, wall paneling and furniture back panels. (15)(17) Its low volumetric shrinkage, smooth texture, and excellent paint and enamel

properties make it equal or superior to many competing woods.

Aspen can also do well in the special use plywood market. Applications where low density hardwoods of uniform structure are required are ideally suited. Basswood has long been well known in this area. There are numerous manufactured articles for which well manufactured panels of aspen plywood are technically superior to high-density hardwoods like oak or to the characteristically non-uniform textured softwoods such as Douglas fir and southern pine. Aspen plywood panels are well suited for overlaying with high quality or fancy face veneers. Cross-banding between surface plies and cores could as well be of aspen veneer as of basswood. Ease of gluing, excellent acceptance of paints and enamels and good wearing properties are definite competitive features of aspen in this area. (17) These are characteristics which aspen possesses in common with such commercially favored species as basswood, white pine and yellow poplar.

The use of overlays and impregnation with resins or resin-forming chemicals can do much to expand the application of aspen. These treatments can be done

from soft, inferior species and result in a product equal in appearance and almost all strength properties to similar material made from a much harder and more valuable species. These treatments also overcome common defects and the high frequency of veneer joints characteristic of aspen plywood. (17) The use of medium and high-density overlay papers has already expanded the use of aspen plywood into the area of concrete forming. (11)

PART IV -- THE MANUFACTURE AND MARKETING OF ASPEN PLYWOOD IN CANADA

The production of aspen plywood on a major scale in Canada is little more than a decade old. It first appeared in volume production in the early 1950's and gained rapid acceptance largely on a price basis. Its initial major uses were underlayment and sheathing which still account for the major share of its market. Recently the production of industrial grades has increased considerably and uses have expanded into printed and painted cabinet work, backing and drawer bottoms in the furniture industry and core stock for facing with more decorative veneers.

Ontario, Quebec and Alberta are the main producing regions for aspen plywood accounting for over 82 percent of total domestic production in 1965. (13) The mail survey of Canadian hardwood plywood mills conducted by the author revealed ten mills presently manufacturing aspen into plywood. Of this number, three were located in Alberta, six in Ontario and one in Quebec. These figures include all of the main producers of aspen plywood and

any others are only supplemental to the industry and represent less than five percent of total production. These mills have a current annual capacity of almost 300 million square feet, ¼" basis. An official of the Ontario Department of Lands and Forests estimated that 35 - 40 percent of this production is in sanded and industrial grades or a capacity of 110 million square feet, ¼" basis.

Present production levels are not up to capacity. (Table 10) Three mills in Ontario were destroyed by fire in 1964 and 65 and are just now resuming production. An additional major mill was constructed during 1966 and one of the older surviving mills has recently completed a major expansion program. When the current expansions and new establishments are completed and the mills that have been destroyed are rebuilt, the capacity of Ontario mills alone producing principally aspen plywood will be approximately 240 million square feet per year, ¼" basis. (38)

Because of these destructions and recent industry expansions, past levels of production have only been in the range of 200 million square feet, ¼" basis, for the entire country. (Table 10)

TABLE 10 -- Canadian Aspen* plywood production 1958-64
thousand square feet - ¼" basis

Year	Total Production
1958	156, 466
1959	179, 487
1960	168, 671
1961	166, 743
1962	163, 488
1963	184, 326
1964	211, 132
1965	196, 029

* includes aspen and cottonwood

Source: Peeler Logs, Veneers and Plywood, 35-001 Dominion Bureau of Statistics, Ottawa. (13)

In general, demand for aspen plywood was strong up to 1959 but suffered a major decline from then until 1963 because of a general slump in the economy. During this period of stagnant demand in 1962 severe price competition was prevalent because of a fear of over-supply on the part of the producers. This fear was short-lived, however, as the increases in production in 1963 seemed to be more than offset by comparable increases in demand.

Demand continued strong in 1963 and 1964 and during these years, expansion was the keynote of the industry. Production was off in 1965 due to the lost capacity in the three Ontario mills damaged by fire. Most of the new capacity should be available in 1967 and a substantial increase in aspen plywood production is expected.

The structure of the industry has changed considerably since its conception. The earliest aspen plywood operations were established with a capacity of between 12 and 15 million square feet, ¼" basis, per annum. The entrepreneurs who established these operations all had previous experience in the lumber industry, but as aspen plywood was a new product, relatively little experience in the plywood industry. The original capitalization of the first mills was well under a million dollars. Currently planned mills have an annual capacity of 40 to 50 million square feet and an estimated cost of approximately 2 million dollars. (38) The payout on investment has been extremely rapid for these mills having been estimated by the Ontario Department of Economics and Development at well under five years, provided a reasonably high level of production could be maintained. This high rate of return ex-

plains why most companies have undertaken and maintained almost continuous expansion since commencing production. The appearance of producers with a strong base in affiliated parent companies and strong, independent producers should add stability to the industry and to the price structure for aspen plywood. Price patterns should approximate the major western domestic plywood producers with minor downward adjustments and discounting in periods of slow demand and price advances as demand increases.

At present, aspen plywood is not a major export item for Canada. In 1964, export shipments were equal to approximately 1½ percent of domestic shipments. (13) Several firms have expressed an interest in American export prospects but none have exported a significant part of their production to date. Part of this interest can be explained by the concern of the Federal Department of Industry and the Ontario Development Agency in export oriented enterprises. (38) At present, domestic production and demand are temporarily in balance but as present capacity limits are attained and further expansion is contemplated, producers will have to pay increasing attention to American and other export outlets.

Aspen plywood entering the U. S. faces a tariff rate of 20 percent ad valorem based on the F.O.B. mill value expressed in U. S. Dollars. Under current currency exchange rates and production cost conditions, this can harly be regarded as a serious tariff barrier. Hardwood plywood consumption in the United States is increasing at approximately 14 percent annually (38) so appears to offer a real opportunity for the expansion of aspen plywood exports within the next few years.

PART V - MICHIGAN AS A SITE OF ASPEN PLYWOOD MANUFACTURE

A survey of 29 plywood and veneer plants in Michigan, Wisconsin, Minnesota and other northern states revealed that, at present, no ordinary hardwood plywood mill is using aspen as its principal species. Several firms, however, are using small quantities of aspen veneer in a number of applications. These include door skins, hardwood plywoods and containers. The survey indicated that entire production of aspen by these mills would not be over 2 million square feet, surface measure, of veneer. A similar square footage of aspen lumber is being used as core stock for lumber core panels. A number of firms indicated some desire to increase their use of aspen but felt that sufficient supplies of suitable material were not presently available.

Michigan should be an excellent site for the establishment of a United States aspen plywood industry. The aspen-birch forest type is the most extensive in the state covering 4.8 million of the state's 19.1 million acres of commerical forest land. (16) This represents over 13 percent of the 36.5 million acres total land area in the state.

TABLE 11 -- Aspen-birch forest type area, commercial forest area and total land area by forest district in Michigan (thousand acres)

Forest Survey District	Aspen-Birch Forest Type Area	Commercial Forest Area	Total Land Area
1) Eastern Upper Michigan	1,102	4,291	5,013
2) Western Upper Michigan	1,122	4,748	5,572
3) Northern Lower Michigan	2,218	7,508	10,736
4) Southern Lower Michigan	357	2,574	15,173
TOTAL	4,799	19,121	36,494

Source: Michigan's Forest Resources 1960 (16)

The regions of highest aspen concentration are located in the Upper Peninsula of Michigan and in the upper half of the Lower Peninsula. (Table 11) Over 20 percent of the total land area in both these areas is covered with the aspen-birch forest type.

Aspen is the most abundant species in Michigan in terms of primary growing stock and in terms of allowable

cut. The present growing stock level of 1,779 million cubic feet is over 300 million cubic feet larger than sugar maple which is the species with the second highest level. Allowable cut shows a similar situation with the aspen level of 72.7 million cubic feet being almost 50 million cubic feet larger than sugar maple. (16)

Actual cut shows an entirely different picture. Aspen is still the species with the greatest utilization but the ratio of actual cut to allowable cut is the lowest of any species in Michigan. This underutilization is true for both poletimber and sawtimber size trees and is also generally representative of all forest survey districts in the state. Veneer and plywood is not the entire answer to this underutilization as there are certain quality requirements of the industry which limits the availability of suitable aspen.

Diameter is one of the major limiting factors. The lowest acceptable limit for most Ontario mills is 9 or 10 inches with some accepting 8-inch material. While it is desirable to utilize several bolts from one tree, many firms will not accept deliveries where the majority of logs are in the lowest acceptable diameter class. The

veneer bolt diameter requirements of most mills might best be described as an average of between 11 and 12 inches with preference, of course, for larger diameter. Even large trees generate a number of smaller bolts from the upper portion of the bole, and a desirable aspen veneer tree would have a diameter breast height of 14 inches or more with a very small taper. Smaller trees, however, must be utilized in the course of a logging operation. Veneer bolt recovery on the best representative Ontario operations has been estimated at 25 to 30 percent of the net stand merchantable volume. (38)

Michigan presently has a standing sawtimber volume of 1174 million board feet of aspen and 135 million board feet of cottonwood. This volume is distributed by diameter class as shown in Table 12.

TABLE 12 -- Net volume of live sawtimber on commerical forest land in Michigan by diameter class and species (million board feet)

Species	Total	Diameter Class (Inches)				
		12	14	16	18	20+
Aspen	1174	775	243	109	18	28
Cottonwood	135	3	1	2	25	104
TOTAL	1309	778	244	111	43	132

Source: Michigan's Forest Resource, 1960 (16)

This diameter distribution would appear to be an adequate source of veneer bolts at present and the available sawtimber supply is increasing at the rate of 147 million board feet annually. (16) From 1935 to 1955 the total volume of aspen and cottonwood sawtimber increased from 476 to 1,309 million board feet or 175 percent while the standing sawtimber volume of all species was showing a net decrease of 10 percent at the same time. (16) Greater utilization of this species is necessary in order for the Michigan forest products industries to expand, and this tremendous increase in ingrowth into the sawtimber diameter classes of aspen indicates excellent potential for this species as veneer or plywood.

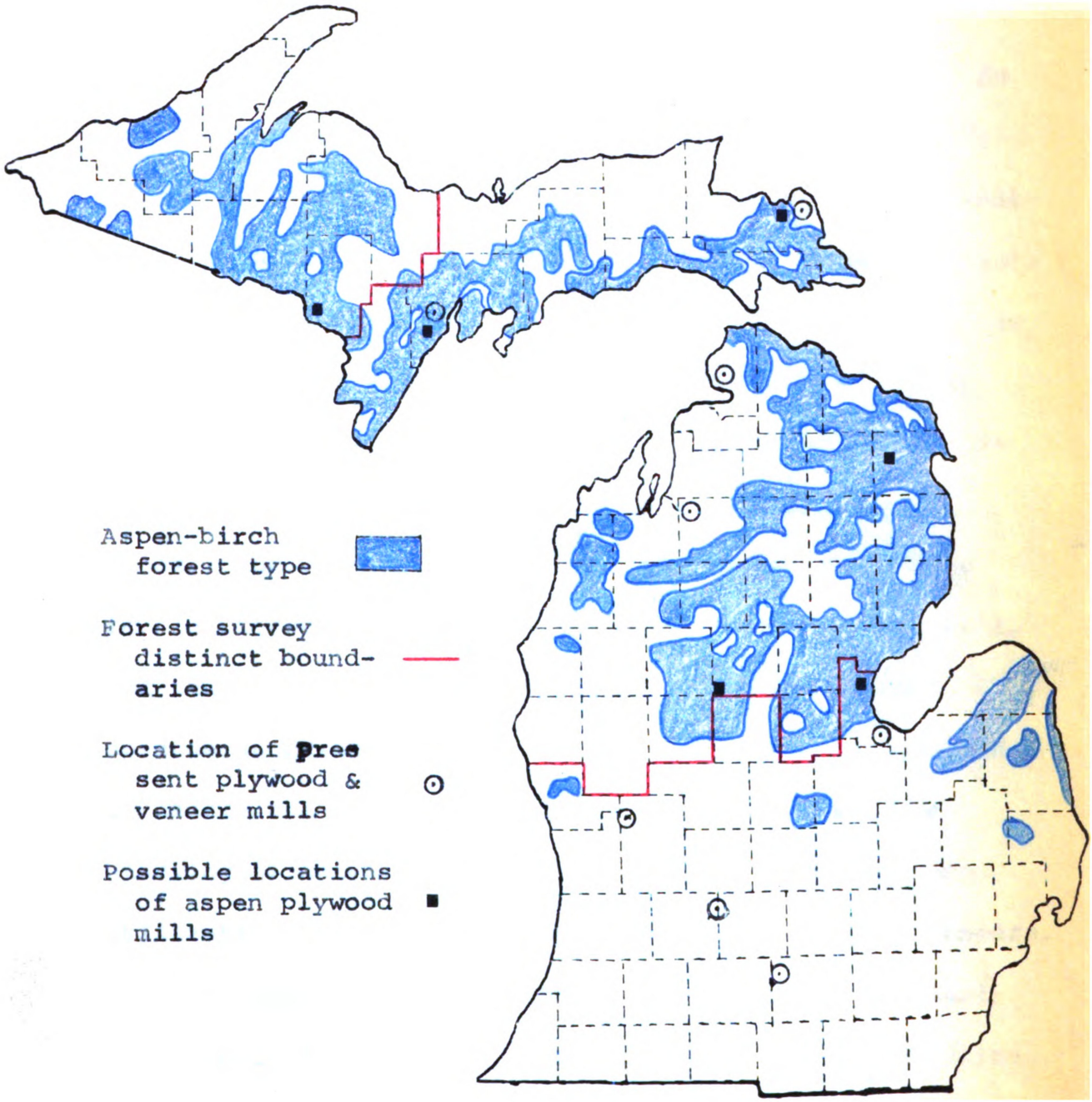
Acceptability of aspen veneer bolts is also limited by knots and fungal conks as well as excessive heart rot. Newer lathes, particularly 8 foot, have a three-inch chuck with a retractable 5-inch or larger outside chuck with a roller nose bar to keep the small diameter bolts from bending. This equipment permits bolts to be turned to 3 - 4 inch diameters and facilitates the utilization of seriously heart rotted bolts at the expense of leaving a larger core waste.

Michigan's aspen resource is distributed as shown in Figure 1. Many counties contain extensive areas of the aspen-birch forest type and offer excellent possibilities as sites for aspen plywood mills. The most promising areas appear to be in the vicinity of the following communities:

Upper Peninsula:	Iron Mountain
	Escanaba
	Sault Ste. Marie
Lower Peninsula:	Hillman
	Clare
	Pinconning

An Upper Peninsula location would appear to offer the greatest potential. These counties generally have a much higher percentage of forest cover than Lower Peninsula areas. (33) More extensive areas of the aspen-birch forest type would offer a larger, available supply of veneer quality logs than the scattered woodlots and other forest areas typical of the more densely populated southern part of the state.

FIGURE 1 -- Distribution of the aspen-birch forest type in Michigan



Source: Michigan's Forest Resources, 1960 (16)

The 1963 Census of Manufacturers (50) indicates that Michigan presently has 11 mills manufacturing veneer and plywood other than for use in containers. Eight of these mills are located in the Lower Peninsula and three in the Upper Peninsula. More recent data from the North Central Forest Experiment Station reveals this figure to be somewhat erroneous as only 8 mills are presently in production. They are distributed as shown in Figure 1. These producers fit into a variety of classifications as five are engaged solely in the production of veneer, two in the manufacture of curved and molded plywood products, and only one producing ordinary hardwood panel stock. The 2 mills in the Upper Peninsula are located in counties suggested as sites for an aspen plywood mill, but they are utilizing only small quantities of that species at present. These mills are not really equipped to handle the unique problems of aspen involving the handling of small logs, peeling to small diameters and utilization of a large proportion of lower quality veneers.

In summary, Michigan appears to offer an excellent opportunity for the establishment of an aspen plywood industry in the United States. The raw material supply, in

terms of growing stock and volume of standing saw-timber, appears to be very adequate at present and rapidly increasing. Not all of this supply would be available for manufacturing as land ownership must be considered and many private landholders may be unwilling to permit logging operations on their property. Consideration must also be given to lands currently tied up by existing pulp and paper, particle-board and other wood-using industries interested in assuring a continuous supply of raw material for their own operations.

Aspen is being tremendously underutilized at present, but greater utilization of this species is the key to the growth of Michigan's forest product industries. An entirely new plywood facility is required to handle the small log, high production problems of aspen. Existing mills are not equipped to handle the species profitably. A number of locations appear to offer good possibilities for mill establishment, particularly in the Upper Peninsula, but a prospective plywood manufacturer considering location would have to conduct his own reconnaissance of the timber resources

and labor supply in the area to ensure that they are adequate. Based on the experience of the Ontario industry, the optimum size of plant establishment would appear to be in the neighborhood of 40 - 50 million square feet, ¼-inch basis, annually and require an initial investment of approximately two million dollars.

PART VI -- THE POTENTIAL FOR ASPEN PLYWOOD IN THE MIDWEST KITCHEN CABINET INDUSTRY

The Market Study:

About 5600 U. S. plants and shops are engaged in the production of kitchen cabinets, sink tops and vanities. (31) In 1963 these firms produced approximately 8 million wood kitchen cabinet units with a value of over 250 million dollars. (3) This figure is increased to between $600 and $700 million when vanities, countertops, plastic laminate and steel kitchens and built-in appliances are considered. (31)

The industry has a wide variety of firms based on plant size and sales volume. The 90 largest national and regional cabinet manufacturers account for over 38 percent of total U. S. sales with individual annual volumes ranging from $1 million to $17 million. The 700 next largest firms account for an equal market share, and their sales volumes range from $150,000 to $750,000. These are primarily regional manufacturers selling over a limited area or up to two or three states. The remainder is accounted for by 4800 small and medium-

sized cabinet shops and plants with individual sales volumes ranging from $10,00 to $125,000. (31)

Future prospects for the industry appear bright as all phases have advanced steadily in the last few years. Growth of the wood cabinet business has averaged 20 percent annually since 1960. The volume of counter tops has grown more than 10 percent annually and vanities have increased to 1,500,000 units per year from a small insignificant figure. (31)

Of this total number of firms, 14 percent are located in Indiana, Illinois and Michigan. (3) These 785 plants account for almost 20 percent of total U. S. sales. This Midwest region is a concentration area for kitchen cabinet manufacturers and is the scope for this study into the potential for aspen plywood.

The objectives of the market study are; to identify the types and specifications of products presently being used in the kitchen cabinet industry in these three Midwestern states; to determine the potential for aspen plywood in this industry, and specifications it would have to meet to compete successfully with products presently being used; to examine distribution

channels, pricing policies and promotion required for the successful introduction of aspen plywood into this market.

The methodology utilized was a telephone and personal interview survey with manufacturers, distributors and other individuals knowledgeable with the market. Contact lists were developed from the files of several professional people in the area and telephone directories of the main centers of population. The firms were interviewed according to a designed questionnaire (Appendix 13) in order to obtain quantitative data as well as permitting discussion of several open end questions.

In all, 42 firms were contacted and 30 usable interviews obtained. This represents approximately 4 percent of all firms in the study area. A usable interview was considered to be one in which enough quantitative information was gained that it could be included in the tabulations of panel use. The reasons for not obtaining satisfactory interviews were: did not have time to answer questions; would not discuss subject by telephone; proper individual not available to answer the question; no use made of plywood or particleboard and no answer or out

of business. Actually, many more than 42 calls were made, because it was often necessary to call three or four times to contact the right person.

The tabulation of panel use by these firms does not represent their total consumption. Since aspen is primarily suited for general purpose applications such as drawer sides, back panels, core stock and painted finishes rather than naturally finished surface applications, the consumption data are restricted to panels presently being used in these applications. No suggestions is made that aspen is a possible substitute for walnut, pecan, cherry and other decorative species highly valued for their natural beauty although it is quite acceptable as a core material upon which these finer veneers can be laid. The panels of main interest from a competitive point of view are Douglas fir, gum, cottonwood and birch plywood and particleboard.

TABLE 13 - Market share of wood based panel products and distribution of each (selected firms in the kitchen cabinet industry).

Product	Market Share Percent	Distribution Number of Firms
Particleboard	41.0	20
Gum Plywood	22.7	4
Birch Plywood	14.1	16

Fir Plywood	12.8	23
[1]Misc. Hardwood Plywoods	7.0	3
Southern Pine Plywood	2.4	2

[1] includes cottonwood, oak and sycamore

Source: Appendix 4

The firms interviewed use approximately 28½ million square feet, surface measure, of wood based panel products annually broken down by grade and thickness as shown in Appendix 4 and 5. Particleboard represents 41 percent of this volume and is being used to some degree by 2/3 of the firms interviewed. (Table 13) Fir plywood has wide distribution among firms but accounts for only 12.8 percent of the volume. This is partially due to the nature of the product. It is not really preferred for any particular application but is generally available at short notice in quantities ranging from a few sheets to full carloads. It is a good general purpose product suitable for numerous applications and reasonably priced. Gum plywood has the second highest market share, 22.7 percent, but is used by a very small proportion of the

firms, 13 percent. Gum seems to be preferred by several of the largest firms for quite specific uses. They tend to use a greater number of products in their units because of their ability to purchase carload quantities of products used for quite limited applications.

TABLE 14 -- Grades and thicknesses of panel products used by selected firms in the kitchen cabinet industry (percent)

	Particle-board	Gum Ply-wood	Birch Ply-wood	Fir Ply-wood	Misc. Hard-wood Ply-woods	Southern Pine Ply-wood
Market Share	41.0%	22.7%	14.1%	12.8%	7.0%	2.4%
Grade:						
A/B[1]				31		16
A/C				2		
A/D				48		
B/B						
B/D				16		84
C/D				3		
1/2[2]			29		32	
1/3		80	70		60	
2/3		15	1		8	
3/3		5				
Total		100	100	100	100	100
Thickness:						
1/8			62			
3/20		10				
3/16	1	13			48	
1/4		77	7	4		16
1/2	20		28	13	20	20
5/8	55			47		
3/4	21		3	36	32	64
1"	3					
	100	100	100	100	100	100

[1] See Appendix 2

[2] See Appendix 3

Source: Appendices 4 and 5

Kitchen cabinet firms are using particleboard primarily for shelving and core stock for plastic laminates. Over 70 percent of the firms using the product use it for one of these two operations. Core stock is the main use with 54 percent of the firms using it for this purpose. (Appendix 6) Almost all the particleboard used is in the range of ½" - 1" in thickness. (Table 14) The quantities used below ½" are insignificant. It is being used for these applications because of its low warping properties when compared to plywood, good surface characteristics with no conspicuous pattern to telegraph through the thin laminates, relatively low price and general availability.

Gum plywood is being used primarily for back and end panels in cabinet units, drawer bottoms and cabinets to be printed with a paper overlay. (Appendix 6) A 1/3 grade is by far the most suitable, representing 80 percent of present consumption. The thickness preferred is ¼-inch but thinner panels, 3/20-inch and 3/16-inch, provide almost 25% of the total gum plywood used. It is being used entirely by several of the largest manufacturers, because it can be readily stained to closely

approximate the face veneers on their units and provides a hard, solid face of light uniform color for printing with overlays.

Birch plywood is finding its greatest application as cabinet doors and end panels of units. Eighty-nine percent of the firms interviewed are using it for these applications. Demand is predominantly centered on the better grades as 1/2 and 1/3 represent 99 percent of total consumption. A uniform white face is also generally specified. A variety of panels are being used with a birch face. They include panels imported from Finland which have a veneer core and are predominantly birch throughout, domestic veneer core birch which has a birch face laid on a core of Douglas fir plywood and particle core birch utilizing a core of particleboard. Birch is commonly used because of its light, uniform color and versatility in finishing. It has a pleasing appearance, moderate price and can be painted, stained or naturally finished readily.

Fir plywood is being used for the greatest number of applications. Some firms are using it for shelving, door stock, back and end panels, drawer bottoms and

core stock for odd-sized, custom-made counter and table tops. This is primarily a function of its availability and moderate price. Fir is the closest to a general purpose panel available on the market. This is reflected by the wide range in grades and thicknesses being used by these firms. (Table 14) It is a product which has proved itself generally acceptable over a long period of time and many smaller firms do not bother to thoroughly test out or have access to other materials.

The miscellaneous hardwood plywoods include oak, sycamore, and cottonwood. They are being used by individual larger firms for certain specific applications such as end panels, drawer bottoms and printed cabinets. These firms have a sufficient volume to order carload quantities of these species for a very specific application. The 1/2 and 1/3 grades are preferred, but thickness varies with the end use. (Table 14)

The size of panels purchased by these firms show considerable variation with the different products. The general trend is for the smaller shops to purchase 4' x 8' or other standard size panels commonly stocked by an indep-

endent wholesaler or manufacturer's warehouse. Purchase of custom cut-to-size pieces requires a minimum order size of carload or truckload lots. These companies generally do not have the volume of business to warrant such large purchases and must rely on the stock of a local warehouse for their supplies. These firms are often manufacturing custom units to architects' or customers' specifications and do not have the production runs of standard units to utilize large volumes of similar size pieces. The large firms can take advantage of this service and 75 percent of them using gum plywood and 100 percent using the miscellaneous hardwood plywoods do so. (Appendix 7) The material most commonly purchased cut-to-size is particleboard. It is commonly purchased in a 25 or 30-inch width and lengths up to 10 feet for manufacture into table and counter tops. These sizes are very standardized and many firms can take advantage of this fact for bulk purchases. For custom tops of the other sizes, a common practice is to replace the particleboard core stock with plywood, generally Douglas fir.

Of all the firms interviewed, 21 percent purchase their panel products in carload quantities, 15 percent in

truckload quantities and 64 percent in volumes smaller than a truckload. (Appendix 8) This is generally a good indication of the size of the firm and the quantity of material they use. A common practice among firms who do not wish to maintain large inventories is to place a blanket order with a local supplier and draw against this order as their production requires. This enables them to purchase at a better price than if they made individual weekly or monthly purchases to meet their immediate needs.

The wholesaler is the preferred source of purchases for firms in the kitchen cabinet industry. Eighty-two percent purchase their panel products through a local wholesaler or broker. (Appendix 9) A number of firms have a mixed policy in that they will purchase some products from a wholesaler channel and other directly from the manufacturer at the mill. This is particularly true of particleboard and hardwood plywood from mills in the southern states.

Requirements for Aspen:

A. End Uses:

Aspen is a potential substitute for other panel products in all applications considered in the market

study. The grades and thicknesses required are somewhat variable but comparable qualities in aspen can be produced. Perhaps the greatest potential in this market is as a specialty type of product aimed at very particular market segments. By this is meant that the product should be promoted and sold in a certain grade and thickness for a very particular application rather than as a general all-purpose panel. This is presently true of gum and the miscellaneous hardwood plywoods. This tends to restrict use to the larger firms purchasing truckload or carload quantities, but they consume the largest proportion of panel products as well as being more receptive to new products.

Aspen is suitable for shelving and cabinet doors in paint grade units. The thicknesses required are 1/2" to 3/4" and grades of B/BB and better.

End, side and back panels are readily made from ¼" aspen. B/BB would be sufficient for the backs of units but an A/BB would be required for sides and ends.

Drawer sides can be made from a 1/2" B/B aspen panel, but the bottoms would require a 3/16" or 1/4" A/C panel.

Aspen is also a suitable substitute for fir plywood

as core stock in custom counter tops where particleboard is seldom used. This would require a 5/8" or 3/4" panel with a B/C being the minimum acceptable grade.

A considerable volume of material is used annually in the manufacture of lower quality cabinets which are imprinted with a woodgrain or other finish or painted rather than naturally finished. Aspen plywood has a solid face of light, uniform color and has excellent painting characteristics to make it very acceptable in this market. An A/C grade in ¼" thickness would be required in these applications.

B. Specifications:

For aspen to obtain any share of the market, it must be available cut-to-size. The bulk of the larger firms purchase most of their material cut-to-size and in some cases machined. Little or no premium can be charged for this cut-to-size service, but additional charges are standard for machining.

The largest volumes can be expected in 1/4" and 3/4" thickness and grades of B/BB and better with a

fairly high proportion of A faces.

Most panels in present usage have an interior glue line and aspen could have a similar adhesive because of a lower price factor and no necessity of exterior protection.

C. Distribution:

The best distribution channel would be through independent, hardwood plywood wholesalers rather than distributors of softwood plywood and lumber. These wholesalers tend to be quite heavy industrially rather than being oriented toward retail and builder accounts.

Most firms interviewed presently purchase through wholesalers or brokers in the Midwest area, and there was no indication of any desire to change this pattern of distribution. These wholesalers have considerable experience in dealing with these industrial firms and feel they can handle any technical assistance required. They are also equipped to give delivery and extend credit to their customers.

Some manufacturers are buying under contract or blanket orders, but the majority seem to purchase individual truckloads or carloads as required.

Lead times for most firms appear to be in the neighborhood of 2 - 4 weeks, but several receive shipments as infrequently as 2 - 3 months. A longer lead time seems to be more characteristic of the larger firms who purchase several carloads at a time.

D. Promotion:

The main promotion required to reach this market would be individual calls by sales personnel liberally supplied with samples so that the prospective customers can try the product. This would be preferable at the wholesaler level, but it is doubtful if they would be willing to expend the required effort for the promotion of one product. If this is the case, manufacturer's representatives would have to be used. Advertising in trade journals may also have some beneficial effect.

E. Price:

Aspen plywood, as a product, appears to have little if any differential advantage over products presently being used by firms in this industry. The physical characteristics are generally equivalent, with aspen being slightly inferior for some applications such as for imprinting

with a woodgrain or other finish. This leaves price as the remaining competitive area and aspen must have a favorable price situation to pose any threat to the other panel products.

Aspen plywood, upon import into the United States, is subject to a 20 percent ad valorem tariff on the F.O.B. mill value expressed in U. S. dollars. (12) All prices shown for aspen are based on F.O.B. mill rates charged by present producers of aspen plywood in Ontario and Quebec with allowances made for the exchange premium, tariff and freight to the Chicago area. (Appendix 12) Domestically produced aspen should be lower in price than these figures, because it is not subject to any tariff charges and freight costs should be lower when shipping from Michigan to Chicago than when shipping from Northern Ontario.

TABLE 15 -- Comparison of carload prices between Aspen plywood and Douglas fir plywood; U. S. $ per M square feet; delivered in Chicago area.

	Fir Plywood		Aspen Plywood	
	A/B Ext.	A/C Ext.	B/B	B/C
1/4"	96	81	143	110
3/8"	126	111	166	145
1/2"	153	138	210	175
5/8"	175	160	232	202
3/4"	201	186	266	236

Source: Appendices 10 and 12

Aspen plywood is not favorably priced when compared to the better grades of fir plywood. (Table 15) This premium of 25 - 40% is caused by the tariff charged on aspen plywood when importing it into the U. S. and the lower price commanded by fir plywood in the U. S. Southern pine is comparable to fir in price so aspen would not be competitive with this species either. Particleboard is lower in price than the solid grades of fir plywood so aspen would be considerably higher than this product also.

TABLE 16 -- Comparison of carload prices between Canadian Aspen plywood and U. S. domestic hardwood plywoods; U.S. $ per M square feet; delivered in Chicago area.

	1/2 or A/B		1/3 or A/BB		2/3 or B/BB	
	1/4"	3/4"	1/4"	3/4"	1/4"	3/4"
Aspen Plywood	174	306	156	290	122	252
Gum Plywood			145	335	135	325
Cottonwood Plywood	195	430	170	405	150	385
Yellow Poplar Plywood			245	485	225	405

Source: Appendices 11 and 12

The situation appears to be entirely different when competing in the better grades and in areas dominated by

domestic hardwood plywoods. Equivalent grades of aspen have a competitive price advantage of from 10 - 50% depending on grade and species. This difference is much more pronounced in the 3/4" thickness than in 1/4", but it is still significant in the latter. (Table 16)

Cottonwood plywood has almost identical properties to aspen plywood being manufactured from trees of the same genus but a different species. The price differential between the two is considerable so aspen would have an excellent opportunity of capturing a share of the cottonwood market.

Domestic hardwood plywoods are almost always sold cut-to-size at these prices so aspen plywood would also have to offer this service. Because of the large margins illustrated an additional charge could be made for this service and the price still be at a competitive level.

Considerable quantities of 3/16" material is used in the domestic hardwood plywoods. This thickness is slightly lower in price than 1/4" stock but the difference is not sufficient to offset the price advantage shown by 1/4" aspen. Both sizes can be used for most

applications so aspen has a competitive price position even against the thinner plywood.

Aspen can be competitive against these hardwood plywoods providing a sufficient quantity of the high grades required by these manufacturers are available and a steady supply assured.

F. The Market for Aspen Plywood:

As previously shown, aspen can be an acceptable substitute for all the panel products considered in the survey. Assuming that with the proper distribution and promotion aspen plywood can obtain a 5 percent market share in the kitchen cabinet industry should give a relatively conservative estimate of its potential. Among the firms interviewed, we would have a volume of 1.4 million square feet, surface measure and if they can be considered a representative cross-section of the 785 firms in Illinois, Indiana and Michigan, we would have an annual volume of 36.5 million square feet in this three state area.

This figure of 36.5 million square feet represents approximately 1/2 of the total production of sanded industrial grades by Canadian aspen plywood mills in 1965. The

kitchen cabinet industry alone could consume the entire industrial grade production of several mills located in Michigan or the other Lake States.

PART VII -- SUMMARY AND CONCLUSIONS

Hardwood plywood is made of plies of wood or composition material, the face ply of which is a veneer from a broadleaf species commonly called hardwoods. Its main uses are for furniture, cabinets of various types, door skins and wall paneling. Plywoods used in the container and packaging industry have an entirely different market situation to ordinary hardwood plywood so are not considered in this study.

Domestic hardwood plywood production increased from 1.3 billion to 1.8 billion square feet, surface measure, from 1961-64. This represents the output of over 300 plywood and veneer mills, most of which are located in the South Atlantic States or the Lake States. Approximately two-thirds of this production has been in "market" plywood while the remainder was "captive" plywood produced by the manufacturer for his own consumption. The main species utilized by domestic firms are birch, lauan, gum and oak. They represent over 70 percent of present production.

During this same 1961-64 period, imports of hardwood plywood increased from 1.1 billion to over 1.9 billion

square feet, surface measure. Imports have been steadily increasing since 1951 when U. S. import tariffs were reduced to 15 percent on birch and 20 percent on all other important species of hardwood plywood. In recent years the primary source for these imports have been Japan, Taiwan, Korea, the Philippines, Finland and Canada in declining order of importance. Birch and lauan are the principal species imported. In 1965 these two species accounted for 88 percent of the total imports of hardwood plywood.

Since almost no hardwood plywood is produced for inventory by domestic manufacturers or exported by the United States, domestic consumption can be assumed to be the sum of domestic production plus imports. During the 1961-64 period, apparent consumption increased from 2.4 billion to over 3.7 billion square feet, surface measure. In the last several years, over 50 percent of this total demand has been met by imports and this trend is expected to increase.

Projected demands for hardwood plywood are forecasted to be 6.0 billion square feet by 1980 and 9.0 billion square feet by the year 2000. Since the United

States industry is faced with an increasing scarcity of quality wood as raw material, imports are expected to expand their market share to 60 - 70 percent of total consumption.

Aspen is a species which has been little utilized for plywood to date, but could be of increasing importance in the United States market in the future. Aspen stumpage is available in considerable quantities in both the United States and Canada and provides excellent possibilities as an imported products or a means of expansion for the domestic hardwood plywood industry. The species is characterized by rapid growth, small diameter and height, and short lives. Recent technological advances have been in the area of utilization of smaller logs of lower quality, and plywood producers can take advantage of these advances to increase their utilization of aspen and provide a substitute for other domestic species.

The manufacture of plywood from aspen requires a specialized type of small-log equipment. The lathe should be small, fast, relatively simple in design and capable of peeling to small diameters. This should be

supplemented with high speed equipment for mechanized handling of bolts and veneer and specialized gluing equipment for edge gluing pieces of veneer into larger sheets.

Aspen can be readily cut into veneer up to 1/20" in thickness but tends to come off the lathe in ribbons when peeled thinner. It frequently has a wool composed of an agglomeration of loose fibers on its surface. This can be eliminated by peeling the bolt at a temperature just above the freezing point with a very sharp knife. Wet spots can also be a problem in veneer that is not carefully dried; and there have been some reports of buckling around areas of irregular grain or fuzziness and collapse in areas of mineral streak, but these are rare occurrances.

The yield of veneer in aspen is generally in the range of 70 percent of the cubic volume of the bolt, when peeling to small diameters. This remainder is lost in rounding waste, clipping and trimming waste, and core waste. Based upon veneer grades used in the CSA Standard 0153-1963 for poplar plywood, a reasonable expectation of grade yields in average size bolts would be:

Grade A -- 5%

Grade B -- 40%

Grade BB - 20%

Grade C -- 35%

The most important properties of aspen for veneer and plywood are its low density for minimizing internal stresses when used as core plies for panels faced with other veneers, its uniformity of structure for producing veneer of equal density throughout and eliminating variations in strength and stability of both veneer and plywood, its light color and enamel holding properties, and its very good gluing properties for producing good quality bonds with either a hot press urea resin glue or a hot press phenol resin glue.

Aspen plywood is suitable for a variety of end uses depending on the grade. Lower grades with the appropriate type of glue bond are suitable for sheathing, underlayment and other general construction purposes. The better grades can find widespread application as general purpose plywood in furniture, cabinets and wall paneling or in the special use plywood market where low density hardwoods of uniform structure are required. Aspen is also used as a substrate

for medium and high-density overlay papers for applications such as concrete form work.

The aspen plywood industry in Canada is quite well developed although of fairly recent origin. The first volume production was in the early 1950's, and it gained initial acceptance as an underlayment and sheathing material. Recently the production of industrial grades has expanded and its use has spread to the furniture, cabinet and other industries. Ontario, Quebec and Alberta are presently the main producing regions and the plants have an annual capacity of almost 300 million square feet, ¼" basis. Present production levels are only in the neighborhood of 200 million square feet annually as some of this capacity has only been recently completed. At present, aspen plywood is not a major export item for Canada because domestic production and demand are temporarily in balance but as present capacity limits are attained producers will have to pay increasing attention to American and other export outlets.

At present, no plywood mill in the United States is using aspen as its principal species, but some are using small quantities in a number of applications.

Michigan should be an excellent site for the establishment of such an industry. The aspen-birch forest type is the most extensive in the area, covering 20 percent of the state's commercial forest land. Aspen is the most abundant species in Michigan and is greatly underutilized at the present time. The diameter class distribution appears adequate for plywood at present and ingrowth into the sawtimber class is quite high. A number of suitable locations in the Upper Peninsula and the upper half of the Lower Peninsula are evident, but a prospective manufacturer would have to conduct his own analysis of the many factors involved in determining the most desirable location. The optimum size of plant would appear to be in the neighborhood of 40 - 50 million square feet, ¼" basis, annually and require an initial investment of approximately two million dollars.

The potential market for aspen plywood appears to be very good. The survey of kitchen cabinet manufacturers in Illinois, Indiana and Michigan revealed a possible market of 36.5 million square feet, annually in sanded industrail grades. This single industry could consume approximately 1/2 of the total production of these grades by Can-

adian aspen plywood mills in 1965.

A market potential of this size should not be neglected. As their capacity expands and exceeds domestic demand, Canadian producers will be taking a harder look at United States markets to dispose of their products. The U. S. demand for hardwood plywood is strong and increasing steadily. Aspen should have little trouble gaining a share of this market providing a steady supply of reasonable quality can be assured. Michigan appears to be the most logical site for the establishment of a U. S. aspen plywood industry. The raw material supply is available in adequate quantities, and the state has a good location as far as access to the Midwestern market area is concerned. The use of aspen for plywood is a definite means of increasing the utilization of the species with a product of high value added by manufacture and contributing to a much sounder base for Michigan's forest products industries.

GLOSSARY

Ordinary Hardwood Plywood -- all grades and types of hardwood plywood other than container and packaging plywood.

Container Plywood -- plywood produced for manufacture into a wide variety of containers and boxes for shipping, storage and dispensing.

Ad valorem -- a tax on goods imposed at a rate percent of the value as stated in an invoice rather than as a specific sum for a given quantity or number.

F. O. B. -- free on board

Flush Door -- a door with a flush surface that is not divided into panels and moldings.

Door Skin -- a face panel of a flush door

Aspen-Birch Forest Type -- a stand in which fifty percent or more of the standing volume is trembling or large-tooth aspen, balsam poplar and paper birch, singly or in combination.

Primary Growing Stock -- net volume of central stem of live sawtimber trees and live poletimber trees from stump to a minimum merchantable 4.0 inch diameter. Excludes dead trees, cull trees and hardwood limbs.

Allowable Cut -- the volume of live sawtimber and poletimber that can be cut during a given period while building up or maintaining sufficient growing stock to meet specified growth goals.

Poletimber Trees -- trees of commercial species that meet

specifications of soundness and form and are in the following d.b.h. range: softwoods 5.0 to 8.9 inches; hardwoods 5.0 to 10.9 inches.

Sawtimber Trees -- trees of commercial species that contain at least one merchantable saw log and that are of the following minimum diameters at breast height (d.b.h.) softwoods 9.0 inches and hardwoods 11.0 inches.

Diameter at Breat Height (D.B.H.) -- tree stem diameter in inches measured outside bark at 4.5 feet above the ground level.

Wholesaler -- a business unit which buys and resells merchandise to retailers and other merchants and/or to industrial, institutional and commercial users but which does not sell in significant amounts to ultimate consumers.

Broker -- an agent who does not have direct physical control of the goods in which he deals but represents either buyer or seller in negotiating purchases or sales for his principal.

Direct Selling -- the process whereby the firm responsible for production sells to the user, ultimate consumer or retailer without intervening middlemen.

Channel of Distribution -- the structure of intra-company organization units and extra-company agents and dealers, wholesale and retail, through which a commodity, product or service is marketed.

Market -- 1) the aggregate of forces or conditions within which buyers and sellers make decisions that result in the transfer of goods and services.

2) the aggregate demand of the potential buyers of a commodity or services.

Market Potential -- a calculation of maximum possible sales opportunities for all sellers of a good or service during a stated period.

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APPENDIX 1

Scientific Nomenclature for Common Types of Ordinary Hardwood Plywood

Common Name	Principal Species
Aspen	Populus tremuloides Populus grandidentata
Birch (yellow)	Betula alleghaniensis Betula papyrifera
(European)	Betula pendula
Gum (black)	Nyssa sylvatica
(red)	Liquidambar styraciflua
Maple	Acer saccharum Acer nigrum Acer rubrum Acer saccharinum Acer macrophyllum
Oak (white)	Quercus alba
(red)	Quercus rubra Quercus velutina
Walnut	Juglaus nigra
Ash	Fraxinus americana
Beech (American)	Fagus grandifolia
(European)	Fagus sylvatica
Cherry	Prunus serotina
Elm	Ulmus americana Ulmus rubra
Magnolia	Magnolia acuminata

Common Name	Principal Species
Sycamore	Platanus occidentalis
Mahogany (American)	Swientenia mahogani Swientenia macrophylla
(African)	Khaya sp. Lovoa sp. Entandrophragma sp.
Lauan (Philippine Mahogany)	Shorea sp. Parashorea sp. Dipterocarpus sp. Anisoptera sp.
Alder (red)	Alnus rubra
(European)	Alnus glutinosa
Spanish Cedar	Cedrela odorata
Sen (Japanese Ash)	Fraxinus mandshurica Fraxinus sieboldiana
Cottonwood	Populus deltoides Populus trichocarpa
Poplar	Liriodendron tulipifera

APPENDIX 2

Veneer Grades Descriptions for Softwood Plywood

N	Special order "natural finish" veneer. Selected all heartwood or all sapwood. Free of open defects. Allows some repairs.
A	Smooth and paintable. Neatly made repairs permissable. Also used for natural finish in less demanding applications.
B	Solid surface veneer. Circular repair plugs and tight knots permitted. Can be painted.
C	Minimum veneer permitted in Exterior type plywood. Knotholes to 1". Occasional knotholes ½" larger permitted providing total width of all knots and knotholes within a specified section does not exceed certain limits. Limited splits permitted.
C plugged	Improved C veneer with splits limited to 1/8" in width and knotholes and borer holes limited to 1/4" by 1/2".
D	Used only in Interior type for inner plys and backs. Permits knots and knotholes to 2½" in maximum dimension and ½" larger under certain specified limits. Limited splits permitted.

Source: American Plywood Association, Guide to Plywood Grades under Product Standard PS 1-66 for Softwood Plywood

APPENDIX 3

Grade Descriptions of Veneer for Hardwood Plywood

Premium grade (1) - for natural finish. The face veneer shall be of the species of hardwood specified and each face shall be made of tight and smoothly cut veneers. When the face consists of more than one piece, the edge joints shall be tight, approximately parallel to the vertical edge of the panel and matched. Some inherent natural characteristics are permitted, but there is some variation among species; however, knots (other than pin knots), wormholes, rough cut veneer, splits, shake, doze, and other forms of decay are not permitted.

Good grade (1) - for natural finish. The face veneer shall be of the species of hardwood specified and each face shall be made of tight cut veneers. When the face consists of more than one piece, the joints shall be tight and approximately parallel to the vertical edge. The pieces need not be matched for color or grain, but sharp contrasts will not be permitted. Some inherent natural characteristics in the given species are permitted but knots (other than pin knots), wormholes, rough cut veneer, splits, shake, doze and other forms of decay are not permitted.

Sound grade (2) - for smooth paint surfaces. The face veneer shall be free from open defects to provide a sound, smooth surface. The veneer is not matched for grain or color. It may contain mineral streaks, stain, discoloration, patches, sapwood, sound tight knots up to 3/4" in average diameter, and small areas of rough cut veneer. Brashness,

splits, shake, doze or other forms of decay will not be permitted.

Utility grade (3) - this grade permits discoloration, stain, mineral streaks, patches, tight knots, tight burls, knotholes up to 3/4" in diameter, wormholes, splits or open joints not exceeding 3/16" and not extending half the length of the panel, cross breaks not greater in length than that of the permissable knotholes, and small areas of rough grain.

Back grade (4) - the species of veneer is at the option of the manufacturer. Knotholes not greater than 2" in diameter and no group of knotholes in any 12" square exceeding 4" in diameter is permitted. Splits 1" wide at widest point may be on one-fourth panel length; those not more than 1/2" wide at widest point may be one-half panel length; those not more than 1/4" wide may be full panel length. Mineral streaks, stain and discoloration, shims, plugs, patches, filler, knots, burls, wormholes, borer holes, and other characteristics are permitted, provided they do not seriously impair the strength or serviceability of the panel for the use for which it was manufactured.

Source: Commercial Standard CS 35-61, Hardwood Plywood, U. S. Department of Commerce, Business and Defense Services Administration

APPENDIX 4

Selected Kitchen Cabinet Manufacturers Volume (thousand square feet, surface measure) of Wood Panel Products - By Grade

	Volume M. sq. ft.	Percent	Percent of Total
Fir Plywood			
A/B	1124	30.8	
A/C	79	2.2	
A/D	1739	47.7	
B/B	13	0.4	
B/D	580	15.9	
C/D	109	3.0	
Subtotal	3644	100.0	12.8
Gum Plywood			
1/3	5176	80.0	
2/3	960	14.8	
3/3	336	5.2	
Subtotal	6472	100.0	22.7
Particleboard	11,659	100.0	41.0
Southern Pine Plywood			
A/B	112	16.5	
B/D	567	83.5	
Subtotal	679	100.0	2.4
Birch Plywood			
1/2	1181	29.4	
1/3	2800	69.7	
2/3	34	0.9	
Subtotal	4015	100.0	14.1

	Volume M. sq. ft.	Percent	Percent of Total
*Misc. Hardwood Plywood			
1/2	646	32.2	
1/3	1200	59.8	
2/3	160	8.0	
Subtotal	2006	100.0	7.0
TOTAL	28,475		100.0

* includes cottonwood, oak and sycamore

APPENDIX 5

Selected Kitchen Cabinet Manufacturers Volume (thousand square feet, surface measure) of Wood Panel Products - By Thickness

	Volume M. sq. ft.	Percent	Percent of Total
Fir Plywood			
1/4	158	4.3	
3/8	8	0.2	
1/2	458	12.6	
5/8	1700	46.7	
3/4	1320	36.2	
Subtotal	3644	100.0	12.8
Gum Plywood			
3/20	624	9.6	
3/16	816	12.6	
1/4	5000	77.3	
1/2	32	0.5	
Subtotal	6472	100.0	22.7
Particleboard			
3/16	80	0.7	
1/2	2321	19.9	
5/8	6427	55.1	
3/4	2498	21.4	
1"	333	2.9	
Subtotal	11,659	100.0	41.0
Southern Pine Plywood			
1/4	108	15.9	
1/2	135	19.9	
3/4	436	64.2	
Subtotal	679	100.0	2.4

	Volume M.sq.ft.	Percent	Percent of Total
Birch Plywood			
1/8	2502	62.3	
1/4	280	7.0	
1/2	1107	27.6	
5/8	6	0.1	
3/4	120	3.0	
Subtotal	4015	100.0	14.1
*Misc. Hardwood Plywood			
3/16	960	47.9	
1/2	400	19.9	
3/4	646	32.2	
Subtotal	2006	100.0	7.0
TOTAL	28,475		100.0

* includes cottonwood, oak and sycamore

APPENDIX 6

Applications of Wood Based Panel Products in the Kitchen Cabinet Industry
(percent of firms using the product)

	Shelving	Cabinet Doors	Back Panels	End Panels	Drawers	Printed Cabinets	Core Stock	TOTAL
Particleboard	20	7	4	11		4	54	100
Gum Plywood			40	20	20	20		100
Birch Plywood	7	46	4	43				100
Fir Plywood	28	7	41	14	3		7	100
S. Y. Pine Plywood	50			33		50		100
*Misc. Hardwood Plywood					33	34		100

* includes cottonwood, oak and sycamore

APPENDIX 7

Sizes of Wood Based Panel Products Purchased by Selected Firms in the Kitchen Cabinet Industry (percentage of firms using the product)

	4' x 8' or Other Standard Size	Cut-to-size	Total
Particleboard	50	50	100
Gum Plywood	25	75	100
Birch Plywood	88	12	100
Fir Plywood	83	17	100
S. Y. Pine Plywood	50	50	100
Misc. Hardwood Plywood		100	100

APPENDIX 8

Size of Average Order of Wood Based Panel Products Selected by Firms in the Kitchen Cabinet Industry (percentage of firms)

Carload Lots	Truckload Lots	Less Than Truckload Lots
21	15	64

APPENDIX 9

Dsitribution Channels Utilized by Selected Firms in the Kitchen Cabinet Industry for the Purchase of Wood Based Panel Products (percentage of firms)

Manufacturer Direct	Independent Wholesaler, Broker or Manufacturer's Warehouse
18	82

APPENDIX 10

Delivered Carload Prices for Douglas Fir Plywood in Chicago Area -- U. S. $ per M. sq. ft.

	Interior				Exterior			
	A/D	A/B	A/A	C/D	A/C	A/B	A/A	B/B
1/4"	73.00	88.00	106.00		81.00	96.00	114.00	
5/16"				63.40				
3/8"	99.85	114.85	132.85	65.85	110.85	125.85	143.85	
1/2"	126.50	141.50	159.50	93.50	138.50	153.50	171.50	
5/8"	144.75	159.75	177.75	107.75	159.75	174.75	192.75	177.75
3/4"	170.35	185.35	203.35	139.35	186.35	201.35	219.35	204.35

Source: Prices are from Crow's Weekly Plywood Letter plus freight at rate of $15.85/M 3/8" to Chicago from Portland, Oregon.

Prepared by:_____
W. S. Good

APPENDIX 11

Delivered Carload Prices for U. S. Domestic Hardwood Plywoods in Chicago Area -- U. S. $ per M. Sq. Ft.

	Gum Plywood		Yellow Poplar Plywood		Cottonwood Plywood		
	1/3	2/3	1/3	2/3	1/3	2/3	1/2
1/4"	145.00	135.00	245.00	225.00	170.00	150.00	195.00
3/4"	335.50	325.50	485.50	485.50	405.00	385.50	430.50

Source: Prices are based on F.O.B. mill plus the $7.29/M 3/8" freight rate to Chicago from Albany, Georgia.

Prepared by: _____
W. S. Good

APPENDIX 12

Potential Carload Prices for Aspen Plywood Delivered in Chicago Area - U. S. $ per M. Sq. Ft. - 48" x 96" Panels

	Standard Sheathing	Select Sheathing	Utility	BB/C	BB/BB
1/4"	68.00	76.00	86.00	101.00	107.00
5/16"	71.00	80.00	92.00	111.00	119.00
3/8"	82.00	91.00	110.00	133.00	144.00
1/2"	113.00	122.00	139.00	163.00	175.00
6/8"	142.00	151.00	169.00	189.00	202.00
3/4"	172.00	181.00	205.00	226.00	235.00

Source: Prices are based on Ontario F.O.B. Mill Prices with allowances for exchange premium. Tariffs and freight from Hornepayne, Ontario at rate of $7.93/M 3/8"

Method of Calculation:

F.O.B. Ontario Mill Price
-8% for exchange to U. S. $
+20% for import tariff
+Freight @ $7.93/M 3/8"

Prepared by: _____
W. S. Good

Appendix 12 -- Continued

B/C	B/BB	B/B	A/C	A/BB	A/B
109.00	122.00	143.00	147.00	156.00	174.00
121.00	136.00	153.00	162.00	183.00	194.00
145.00	154.00	166.00	182.00	189.00	204.00
175.00	193.00	210.00	214.00	231.00	246.00
202.00	240.00	232.00	242.00	253.00	269.00
236.00	252.00	266.00	277.00	290.00	306.00

APPENDIX 13

FIRM NAME _____ ADDRESS _____

TYPE OF BUSINESS _____

	End Use	Panel Prod.	Annual Cons.	Sand Uns
1. Are you using any poplar plywood or other wood-based panel products. 2. What is your estimated annual consumption of each. 3. What is the end-use product or component.				
4. What grades of panel do you use. 5. What size, (4x8, over 4x8, under 4x8).' 6. What thickness. 7. Interior or exterior bond.				
16. What is the current price to you. 17. Is that C/L, LCL or what. 18. Is that delivered, net tax included, or are there volume discounts or annual discounts to be deducted. How much.				
8. Explore use or need of oversize or cut-to-size panels. What factors restrict ordering odd sizes(shipment,prices?). Any trends to need or use of odd sizes.				

Appendix 13 -- Continued

%	Grade	%	Size	%	Thick	%	Bond	%	Price	Price Basis

Appendix 13 -- Continued

9. What characteristics make one panel product more or less satisfactory than others. (surface, strength, availability, price?)
10. What trends are evident in the use of the different panel products. Have you changed products in recent years and for what reasons.
11. What is the usual size of your average order. (60,000 lb/ C/L, 40,000 lb. T/L 1,000 sq. ft.?)
12. What is the best shipment item - that is how much lead-time inventory is carried. (week, 2 weeks, 1 month).
13. Is the need for small, rush fill-in orders often, occasional or rate. Get prompt service from supplier or self pick-up.
14. Would mixed car delivery be advantageous. For example a carload of lumber, plywood and particleboard. Can you get such service now from supplier.
15. Do you buy through wholesaler, retailer or manufacturer direct.
16. 17. 18. Prices on first page.

APPENDIX 14

QUESTIONNAIRE

1. Do you manufacture Aspen plywood? YES_____

   NO_____

   If YES in Question 1, please continue.

2. What is your approximate annual production of Aspen plywood? (¼" basis)

   less than 10,000 square feet _____
   100,000 - 500,000 square feet _____
   500,000 - 1,000,000 square feet _____
   more than 1,000,000 square feet _____

3. What grades do you produce in Aspen plywood?

	Grade	% of Total Aspen Production
1.		
2.		
3.		
4.		
5.		
6.		

4. What thicknesses do you produce in Aspen plywood?

	Thickness	% of Total Aspen Production
1.		
2.		
3.		

4. _____
5. _____
6. _____

5. What are your major markets for Aspen plywood?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

6. What are the approximate truckload or carload prices for Aspen plywood by grade and thickness classification?