UNIVERSITI PUTRA MALAYSIA

MARKET POTENTIAL OF ORIENTED STRAND BOARD (OSB) & LAMINATED OSB (LAMI-OSB) IN ASIA PACIFIC

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BY

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Thesis submitted in fulfillment of the requirement
for the Degree of Master of Science in the Faculty of Forestry,
University Putra Malaysia.

May 2001

ACKNOWLEDGEMENT

I wish to express my heartiest gratitude to Dr. Shukri for giving me a chance to work with the very demanding yet enjoyable project. His guidance and motivation are most appreciated.

Special thanks should also be conveyed to all my colleagues and friends for their support and help in sourcing for the much vital information in completing this thesis.

Lastly, I would like to thank Pei Chean for her understanding and support given to me in the process of completing this master course.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ASTRACT

With the recent reduction in local forest concessions and environmental issues worldwide, logs supply are limited and have to be purchased at a higher premium. Therefore, the use of plywood and sawn timber are no longer viable.

One solution to this is to use OSB as an alternative. OSB is a structural panel suitable for a wide range of construction and industrial applications. OSB has gained tremendous market share in the North America and popularity is also now booming in Europe, and the Asia Pacific is seen as the next region with the great potential for OSB product development.

This thesis provides an insight to OSB and Lami-OSB, and further explores into the potentials of these products on how it could be accepted in the Asia Pacific region as a new structural panel commodity product.

Chapter One

Introduction

1.0 Introduction

Asia Pacific has been increasingly looked upon as a potential market for oriented strand board (OSB). Although the application of OSB in wood frame residential construction is still uncommon outside North America, there are still many possible applications of this product in the region. The targeted market will be on construction sector especially on concrete shuttering boards where solid wood and plywood are widely used in the sector.

1.1 Problem Statement

With the recent reduction in local forest concessions and environmental issues worldwide, logs supply are limited and have to be purchased at a higher premium. Therefore, the use of plywood and sawn timber are no longer viable.

One solution to this is to use OSB as an alternative. OSB is a structural panel suitable for a wide range of construction and industrial applications. However, conventional OSB has a rough surface made up of overlapping strands aligned at different level and is therefore not suitable for smooth concrete shuttering. Furthermore, OSB is not produced in this region. Thus, the cost of shipping and importation increases the cost of OSB to the point that it may not be an economical alternative.

Laminated oriented strand board (Lami-OSB), which can be produced locally, has been proposed as the best alternative for this application. This product has considerable bending strength and other highly desirable properties derived from its structure. Thus, this gives the Lami-OSB the potential to be the best competitive and economical alternative for wooden materials used in construction sector.

1.2 Objective

The objective of this project is to determine the market potential for OSB & Lami-OSB in the Asia Pacific region. The report will focus in exploring the field of applications where OSB & Lami-OSB could fit itself into the wood industries.

This report aims at determining how OSB and Lami-OSB could adapt to the regional needs as a commodity product. Effort will be made to gather information on the properties of OSB & Lami-OSB to find out how it compares physically to other form of timber products. Information would be sourced to determine and to predict the current and future timber market trend. Then analysis will be made to investigate if the predicted trend is in favour to the introduction of these products to the market place.

Chapter Two

Literature Review

2.0 What is OSB?

OSB is one of the dominant wood composite panel products in North America today. OSB is a structural panel suitable for a wide range of construction and industrial application. It is another type of reconstituted panel or engineered structural wood panel that is composed of compressed wood strands arranged and aligned in layers at right angles to one another and bonded with adhesive such as phenol-formaldehyde or isocyanate, under intense heat and pressure.

Having evolved from waferboard, OSB entered the structural panel market in the early 1980s and has evolved through ongoing research and development in composite wood technology. The OSB industry is now well established in North America and growing rapidly.

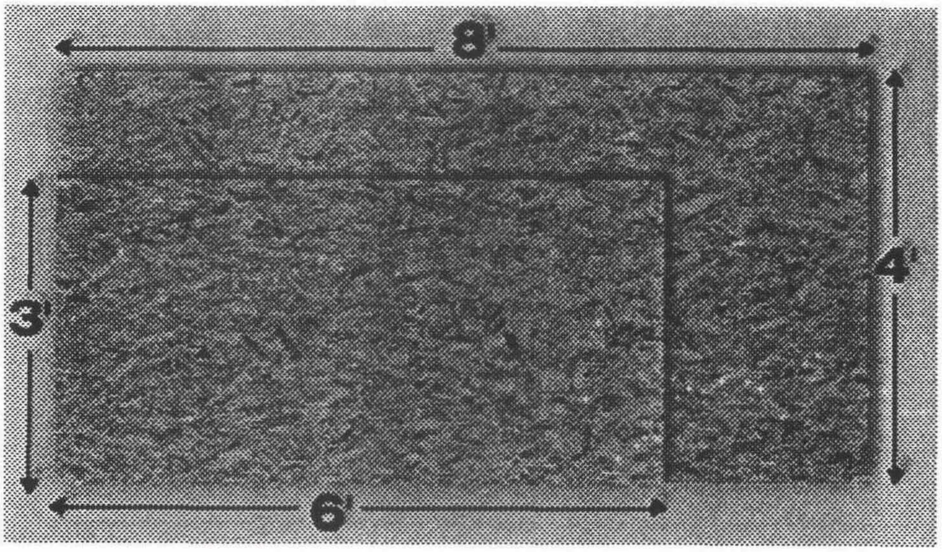

Figure 1: OSB Panels

2.1 What is Lami-OSB?

Lami-OSB is a further derivative of OSB, it is a product developed jointly by Forest Research Institute, Malaysia (FRIM), University Putra Malaysia (UPM) and a reputable local panel producer. It is principally an OSB with smooth particleboard fine material filled on its surface. This will give a smooth surface for the conventional OSB. The outermost surfaces can be laminated with phenolic film paper. Like OSB, the final product will have a considerable bending strength and other highly desirable properties derived from its structural.

As the similarities of OSB and Lami-OSB in terms of physical property and potential application are almost identical, the research exercise to be performed here will base on the core product – OSB, whereby further niche requirement to be adopted in the Pacific rim on Lami-OSB will be elaborated later on.

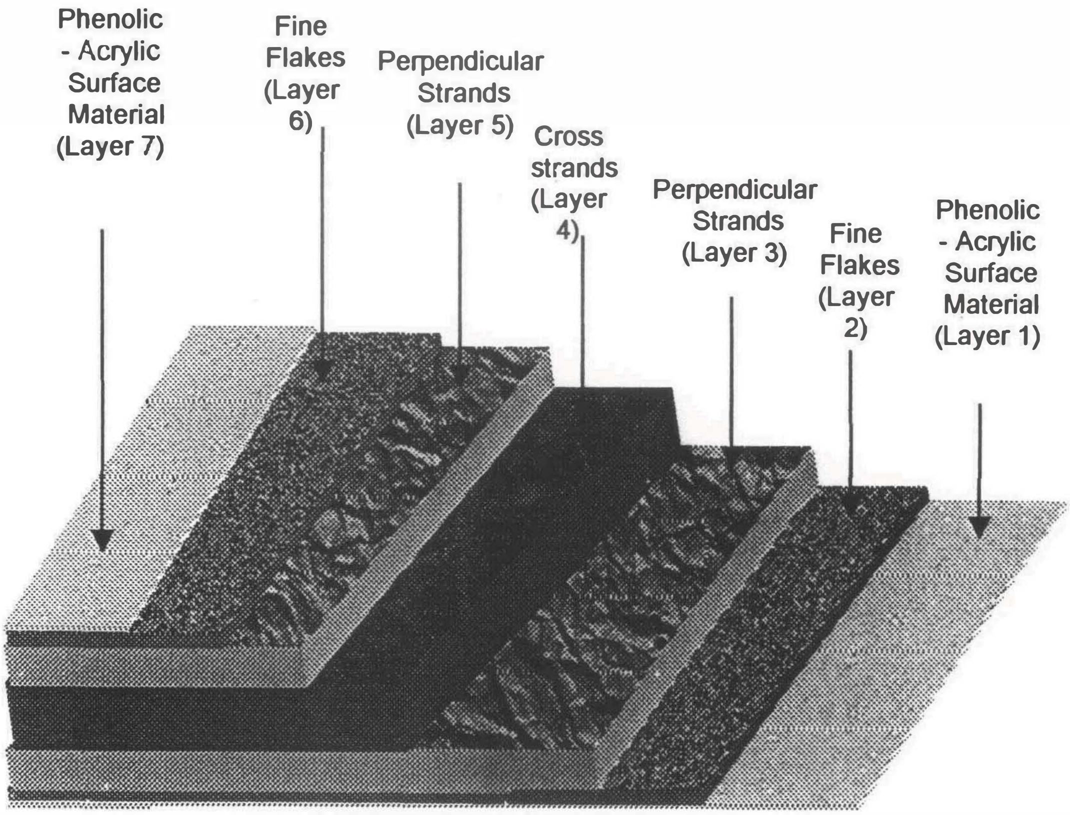

Figure 2: Composition of Lami-OSB

2.2 Manufacturing Process of OSB

OSB is manufactured in three or more layers with the strands of both surface layers aligned in the longitudinal panel direction, while those of the core layer are aligned perpendicular to the length of the panel. The alignment of strands gives OSB panels improved mechanical properties (strength and stiffness) and physical properties (dimensional stability) in the direction of alignment.

In the general manufacturing process for OSB, debarked logs are sliced into thin wood elements. The strands are dried, blended with resin and wax, and formed into thick, loosely consolidated mats that are pressed under heat and pressure into large panels. OSB is made from long, narrow strands, with the strands of each layer aligned parallel to one another but perpendicular to strands in adjacent layers, like the cross-laminated veneers of plywood. It is this perpendicular orientation of different layers of aligned strands that gives OSB its unique characteristics and allows it to be engineered to suit different uses.

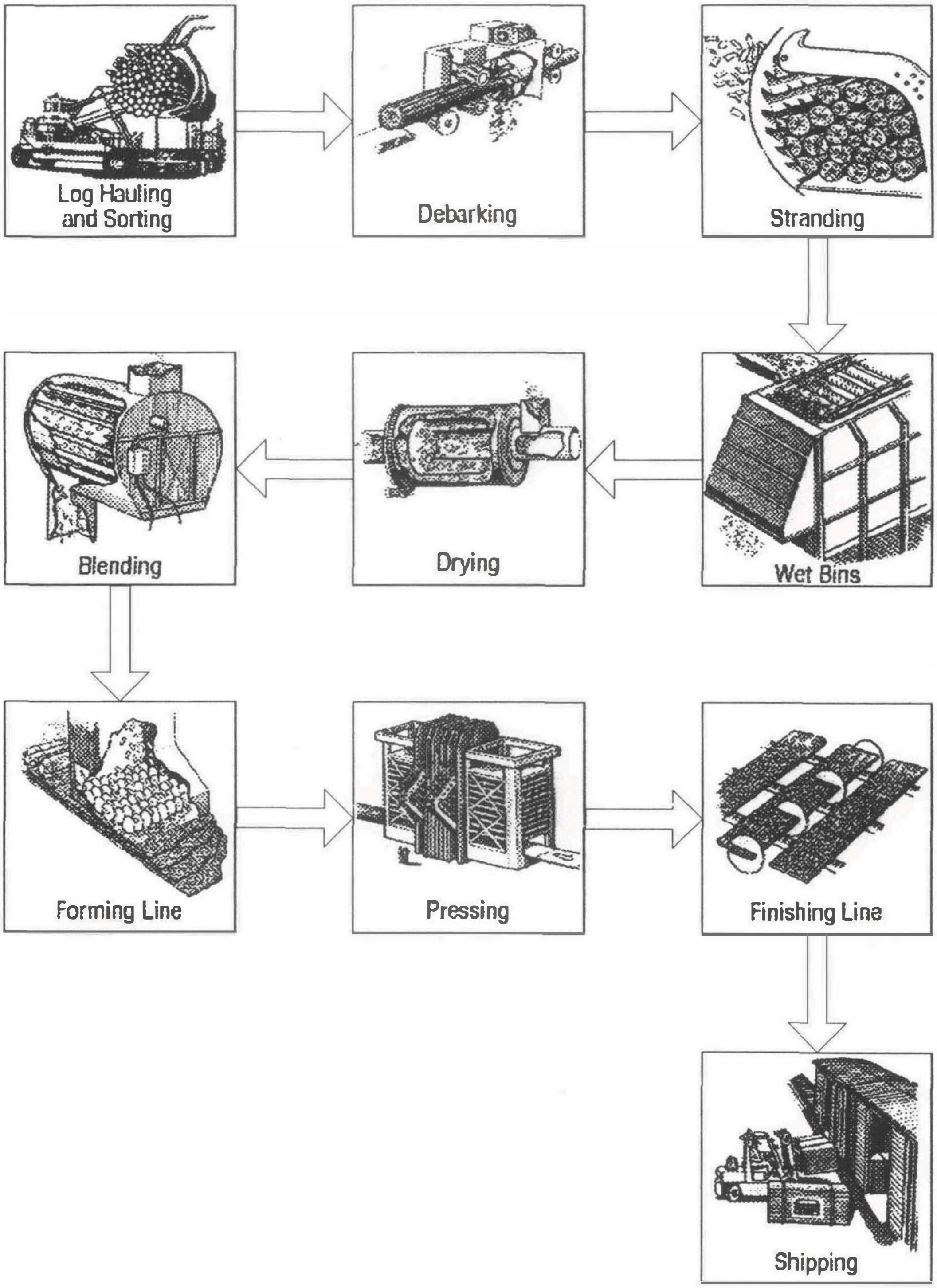

Figure 3: Manufacturing Process of OSB

2.2.1 Raw Materials

The original waferboard product, made from square wafers, used aspen. As this industry expanded and OSB became the predominant product manufactured, other species such as southern yellow pine, white birch, red maple, sweetgum, and yellow-poplar were found to be suitable raw materials as well. Small amounts of some other hardwoods can also be used for OSB.

2.2.2 Stranding Process

Typically, logs are debarked and then sent to the stranding process. Long log disk or ring stranders are commonly used to produce wood strands typically measuring 114 to 152 mm long, 12.7 mm wide, and 0.6 to 0.7 mm thick.

2.2.3 Drying Process

Green strands are stored in wet bins and then dried in a traditional triple-pass dryer, a single-pass dryer, a combination triple-pass/single-pass dryer, or a three-section conveyor dryer. A relatively recent development is a continuous chain dryer, in which the strands are laid on a chain mat that is mated with an upper chain mat and the strands are held in place as they move through the dryer. The introduction of new drying techniques allows the use of longer strands, reduces surface inactivation of strands, and lowers dryer outfeed temperatures. Dried strands are screened and sent to dry bins.

2.2.4 Adhesive Application or Blending

The blending of strands with adhesive and wax is a highly controlled operation, with separate rotating blenders used for face and core strands. Typically, different resin formulations are used for face and core layers. Face resins may be liquid or powdered phenolics, whereas core resins may be phenolics or isocyanates. A number of different resin application systems are used; spinning disk resin applicators are frequently used.

2.2.5 Mat Formation

Mat formers take on a number of configurations, ranging from electrostatic equipment to mechanical devices containing spinning disks to align strands along the panel's length and star-type cross-orienters to position strands across the panel's width. All formers use the long and narrow characteristic of the strand to place it between the spinning disks or troughs before it is ejected onto a moving screen or conveyor belt below the forming heads. An oriented layer of strands within the mat-face, core, face, for example-are dropped sequentially, each by a different forming head. Modern mat formers either use wire screens laid over a moving conveyor belt to carry the mat into the press or screenless systems in which the mat lies directly on the conveyor belt.

2.2.6 Hot Pressing

In hot pressing, the loose layered mat of oriented strands is compressed under heat and pressure to cure the resin. As many as sixteen 3.7- by 7.3-m (12- by 24-ft) panels maybe formed simultaneously in a multiple-opening press. The press compacts and consolidates the oriented and layered mat of strands and heats it to 177°C to 204°C to cure the resin in 3 to 5 min.

2.3 Manufacturing Process of Lami-OSB

The manufacturing process for Lami-OSB is exactly the same as conventional OSB. The only difference is that it needs a separate particleboard fines material preparation facility. This would include a chipper to convert logs into chips, followed by flaking process to reduce the chips dimension into flakes. After flaking, the wet flakes would be dried in a flu-gas dryer. Screening process would follow to screen out over sized flakes, where the over sized would be further reduced into fines in a refiner.

The fines would be blended with resin the same way as a particleboard blending process and then fed into the top and bottom surface formers. Fines materials would be distributed and formed onto a moving metal belt to provide the OSB strands with fine surface finishing. After the OSB panel with smooth surface is produced, the product could later be laminated with phenolic overlay paper to offer the board with waterproof and more durable properties.

A separate particleboard fines material preparation section could be eliminated if an accurate material balance could be reached. After the stranding process at the waferizer, the strands would be screened and those undersized strands could be diverted into a refiner to produce fines material. If this balance could be achieved, a separate particleboard fines material preparation green end investment could be kept to a minimum, if not totally eliminated.

2.4 Physical Properties of OSB & Lami-OSB

Wood products are always by far the most commonly used material in all sorts of applications. It is the type of natural product that provides the most flexibility in terms of utilization and economic sense. A few facts on wood products are briefed as follow:

- When compared by weight, wood is used more than all plastics, metals, and concrete combined.
- Pound for pound, wood is stronger than steel because it has a more favorable strength-to-weight ratio.
- Analysis of earthquake damage in California and Japan revealed that panel sheathed wood frame structures fared better than did masonry and concrete buildings.

The physical and mechanical properties of OSB make it suitable for a wide range of structural and non-structural applications. It is widely used in residential construction and gaining recognition in the commercial construction industry.

OSB's strength comes mainly from the uninterrupted wood fiber, interweaving of the long strands or wafers, and degree of orientation of strands in the surface layers. Waterproof and boil proof resin binders are combined with the strands to provide internal strength, rigidity and moisture resistance.

2.4.1 Structural stability

Moisture content of jointed materials is highly influential of total stiffness of OSB in sheathing applications. High moisture content results in lower stiffness, and OSB jointed to dried lumber up to 3 times as stiff as that jointed to green lumber (Mohammad 1994). One of its limitations is its susceptibility to moisture as it is not durable in applications where it is subject to prolonged wetting (Illston 1994).

Table 1: Screwing and nailing performance test on plywood

1/2" CDX Plywood				
Average Pull-out in Pounds	As Received	Pulled Wet	Pulled After Drying	Driven Wet, Pulled Dry
Shingle Nail	50	52.5	60	45
O.C. Screws	46.3	40	52.5	47.5
Staples	50	50	50	----
Square Head Nails 95	100	142.5	127.5	
Simplex Screws	317.5	251.3	307.5	290

[Source: APA-The Engineered Wood Association, 1994]

Table 2: Screwing and nailing performance test on OSB

1/2" Oriented Strand Board				
Average Pull-out in Pounds	As Received	Pulled Wet	Pulled Drying	Pulled Dry
Shingle Nail	47.5	42.5	33.8	40
O.C. Screws	51.3	45	48.3	47.5
Staples	50	56.3	58.8	----
Square Head Nails 100	70	110	122.5	
Simplex Screws	240	217.5	225	202.5

[Source: APA-The Engineered Wood Association, 1994]

By referring to Tables 1 & 2, it is observed that both OSB and plywood have almost the equivalent withdrawing pulling force with various type of nails and screws when the wood is in dry condition. However, OSB tends to behave less satisfactory than plywood when the panel is wet. It is obvious that OSB has weaker withdrawing pulling force when the panel is wet using shingle nail. When the board has dried, the pulling force using shingle nail is even weaker than when it is wet, scoring almost only half the pulling force attained in plywood for the same given condition. But using different nails and screws system to achieve comparable performance as with plywood could easily rectify the weakness in wet OSB panel performance. In short, OSB can still be a great performer provided the right accessories are used for the right application with the correct method.

2.4.2 Bending strength and stiffness

The progression of wood composite materials to structural applications required them to have mechanical properties that approach those of wood. OSB does this through flake alignment.(Shaler 1991). The modulus of elasticity (MOE), Modulus of rupture (MOR), internal bonding (IB) and tensile strength (TS) of OSB improves as resin content increases from 4 to 6% (Avramidis 1989). The spot resin bonds used in manufacture are, in themselves, not strong. Consequently the boards are particularly weak in tension perpendicular to the flat surface of the particles. However, the product is rarely used in a way that would place this kind of stress on the board. The compression of the mat to produce the board adds to its strength greatly by interlocking the fibres making up the particles (Kubler 1994). However, the strength properties of (bending strength and stiffness), while around greater than that of waferboard, are still not as good as plywood.(Illston 1994).

OSB is generally prone to swelling when the panel is exposed to moisture and hence its usage is normally limited to interior application. As mentioned earlier that OSB would replace plywood in the construction sector as concrete shuttering board, but because of the rough surface of conventional OSB panel board and its sensitivity towards moisture, which would cause swelling and make a short fall for its potential use as shuttering board. But Lami-OSB with smooth surface finishing is suitable for surface lamination. Lami-OSB could be laminated with phenolic overlay paper that is waterproof and scratch resistant to enhance its durability as a concrete shuttering board. Because of the smooth overlay, the shuttering board could be easily detached from the concrete formwork and this can increase the cycle of usage for the shuttering board.

2.5 Advantages of OSB

OSB has a number of clear advantages over plywood. Being engineered, OSB offers much greater board size variation (even up to 2.4m x 7.3m). Unlike plywood, the dimension of plywood is generally dependent on the length of the raw material, this in turn restrict plywood's dimensional flexibility. Also, OSB panel surfaces are uniform and are consistently free of knots, splits and voids, making them easy to saw, drill, nail, plane and sand. OSB's production process makes it possible to manipulate resin content and strand orientation to produce stiffer or more flexible panels.

OSB also has the advantage of being cheaper to produce than plywood and less dependent on increasingly scarce resources. Diminishing timber supplies favour engineered wood panels, particularly OSB. Where large diameter logs are required for plywood production, OSB makes use of fast-growing, small diameter trees, up to an extent that rubber tree branches with fair straightness could also be used. As such, raw material availability is better and costs are lower. OSB gets almost twice the yield from trees, as does plywood. (There is no log core left in the OSB production process.) In Malaysia, there is virtually no commercial value for rubber tree branches, and most people use it as fuel wood as it cannot be sawn into valuable sawn timber. By utilizing this as raw material for OSB production, it could fetch a considerable lower material cost than plywood, hence lowering the production cost.

Many of the world's plywood plants also tend to have low efficiency because they rely on less-than-modern technology and equipment.

There are a lot of merits for the utilization of rubberwood as raw material for OSB & Lami-OSB production. In general, rubberwood is homogenous with a pale white cream colour texture and has air dry density of about 560-650kg/m^3. This makes the manufacturing process fairly easy in producing panel boards with consistent quality, as the raw material is homogenous. Bark on rubberwood is also relatively easy to be removed by simple knocking motion, this enables drum debarker to be used. A drum debarker is easy to built and maintain, and most importantly it is able to provide higher process capacity as compared to ring debarker.