Usage of plywood, the original engineered wood panel, continues to grow worldwide. North American plywood production and consumption has finally stabilized (2012-2016) after a long period of consistent declines. The decline was particularly sharp during the years of the Great Recession. **EXHIBIT 1**

Concurrently, Oriented Strand Board (OSB), plywood’s lower cost structural panel competitor, continues to flourish in North America and is becoming more widely accepted worldwide. North American annual volume of 16.8 billion feet (3/8” basis) in 2012 grew to nearly 22.0 Billion in 2016 as the North American economy slowly rebounded and producers increasingly offered value-added panels.
Since the 2008 Great Recession, North American panel industry mill count (including LVL, MDF, and Particleboard in addition to OSB and Plywood) has declined about 25% in aggregate. **EXHIBIT 2** But, now the North American wood-based panel industry is again growing.

<table>
<thead>
<tr>
<th>N.A. OPERATING MILL COUNT</th>
<th>2006</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVL</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>MDF</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>OSB</td>
<td>64</td>
<td>48</td>
</tr>
<tr>
<td>Particleboard</td>
<td>36</td>
<td>25</td>
</tr>
<tr>
<td>Plywood</td>
<td>86</td>
<td>60</td>
</tr>
</tbody>
</table>

What then are the current drivers in North America and worldwide? What are the trends and headwinds that influence survival and growth? These questions and others are just now being answered as the North American and global economies struggle through the slowest post-recession recovery in modern times.

**Plywood and Veneer Based Products, a Global Overview**

Plywood is properly considered the pioneering engineered wood panel. Typically constructed with alternate grain direction between layers, plywood’s unique attributes of stability, strength, durability, and beauty continue to offer the versatility that satisfies new uses in addition to retaining many of its traditional applications. Understanding plywood’s highly competitive operating environment, and determining how to best meet customer needs, is the key to future growth.
Three trends are rapidly changing the dynamics for the plywood and veneer-based producer.

- Raw material comes in an increasing array of suitable species and types. Non-traditional log diameters and species are becoming less and less of a barrier to efficient operation.

- Veneer’s high strength-to-weight characteristics make it a versatile raw material that can be assembled into plywood and other veneer-based products that compete with construction materials such as lumber, steel, and concrete.

- Plywood can be successfully manufactured from a wide variety of technologies ranging from crude to sophisticated. Plywood manufacturers use simple technology in some regions, but in other regions automation, robotics, and other technologies increasingly play a key role.

The saying that plywood has 1000 uses is probably conservative. Certain newer veneer-based applications are evolving away from the traditional flat panel into uses recently conceived and developed. Laminated veneer lumber (LVL), now a mature product, is something more than a parallel laminated plywood assembly; and even now one West Coast manufacturer is gearing up to produce a Mass Plywood Panel (MPP) that could challenge layered solid lumber systems in constructing high rise wood-based structures. The common thread for the successful producer is creativity in manufacturing a lower-cost product from the available labor, raw material, and capital.
Production increases mostly in Asia are driving the overall global increase. Over the past three decades, China has become the world’s largest producer with thousands of generally small mills. **EXHIBIT 3**

In our view, China has increased production at a pace that is not indefinitely sustainable.

**North America Plywood’s Competitive Headwinds**

Plywood is a globally traded product. International plywood trade more than doubled to $14.4 billion in 2015 from $6.6 billion in 2000. One source states that “The global market for plywood is projected to reach 223.4 billion cubic meters by 2022, driven by recovering construction activity in most countries worldwide; rise in high value, high rise construction, a growing preference for plywood in interior design especially for floors, ceilings, and walls, and a healthy furniture industry.” North American producers face competitive headwinds in growing production at the same pace as global demand.

According to USDA Foreign Agricultural Service trade data for 2016, structural plywood imports into the United States increased 49% percent to a full year total of 1.4 billion feet.
(3/8” basis); or roughly 15% of United States production. In particular, import volume from Brazil doubled and imports from Canada and Chile also grew. **EXHIBIT 4** Stated differently, imports roughly equal four larger-capacity North American mills.

In addition, Chinese softwood plywood production, while not yet a significant exporter to North America, will exceed the combined production of Europe and North America. Currently the majority is consumed internally, but in time China could join Brazil and Chile as a significant exporter of softwood plywood to North America.

Lackluster industry performance in North America is provoking considerable soul-searching. Thoughtful questions include what changes have occurred? What are the implications for now and over the longer term? How can this analysis provide a basis for decision-making in 2017 and later? What can the North American producer do to prosper within a global market?
Four action steps, as tailored for individual mills, can make the key difference.

1. **Green End: Key to Volume and Yield.** Action steps often will include the introduction of advanced electronic innovations in conjunction with redesigning equipment and processes, while reshaping the people processes to emphasize involvement and engagement.

2. **Dry End: Multiplying Efficiency.** Where feasible introduce the ‘latest generation’ veneer dryers. State-of-the-art dryers will double production in half the floor space compared to many older veneer-drying systems.

3. **Marketing: Overcoming Incorrect Perceptions.** Overcoming incorrect perceptions that define plywood for many potential users, and educating the market on innovative new uses.

4. **Leadership: Changing the Workplace.** Adoption of best management practices and a new collaborative leadership style is required to knowledgeably ‘connect the dots’ of a renewable resource, an advancing manufacturing process, and continually evolving customer needs.

The operating environment will continue to evolve in unpredictable ways. However, the best answers will come from adapting innovative “thinking and doing’ appropriate for each mill’s unique circumstances. The “survivors of the survivors” will be those that nimbly adapt to the changing business paradigm for plywood.

**What ahead for OSB, MDF and other wood based Panels**

Oriented Strand Board (OSB) is a phenomenal example of product acceptance and growth since its rollout as the ‘poor man’s plywood’ during the early 80’s. This reconstituted board product has steadily won market share from plywood. Currently, it is making significant inroads into underlayment and furniture frame markets that have long been dominated by plywood. What is the future of OSB?

OSB is slowing but surely becoming globally accepted with plants now in at least fourteen nations; these plant sites literally span the globe including OSB mills in the southern hemisphere.
Some believe that offshore producers will not become substantial exporters for many years because of growing local demand. Others believe that the shipping costs associated with heavy OSB panels confine it to local markets. But in our opinion it is certain that OSB will cross national boundaries with the main determinate being manufacturing cost, transportation cost, and the currency relationships and trade policies that govern global trade.

**North American Wood is an Environmentally Friendly Building Material**

Preservation of the natural environment has become increasingly important to society. Plywood and other panel products made in North America now come from a renewable resource, with a wide variety of species from diverse growing sites. Virtually the entire delivered timber stem is transformed into veneer or a usable byproduct. In fact, wood is more environmentally friendly than competing construction materials.  
**EXHIBIT 5** Depending on the zone within North America, the replanted tree will again be ready for harvest in 25 to 100 years.

<table>
<thead>
<tr>
<th>COMPARATIVE ENVIRONMENTAL PERFORMANCE INDICES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Embodied Energy</strong></td>
</tr>
<tr>
<td>WOOD</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td><strong>Global Warming Potential</strong></td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td><strong>Air Emission Index</strong></td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td><strong>Water Emission Index</strong></td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td><strong>Solid Waste (total kg)</strong></td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

Embodied energy is the energy consumed by all of the processes associated with the production of a building, from the mining and processing of natural resources to manufacturing, transport and product delivery.

*source: Consortium for Research on Renewable industrial Materials*
Building Greenfield Panel Manufacturing Plants in North America...Again!

The world is rapidly becoming a single market in which products compete primarily on delivered selling price. The unresolved question is how the North America panel producer will stay competitive.

The textbook answer is to control major costs such as wood fiber, labor, energy, glue and other chemicals, and the costs of selling and market logistics. The ongoing Goal is to provide the highest quality product at the lowest price, while creating a profit for the shareholders. That is a tall order, and the stakes are high.

According to the American Forest and Paper Association (AF&PS), the U.S forest products industry employs about 887,100 workers and accounts for approximately 6% of total U. S. manufacturing GDP. These results place the industry roughly on par with the automotive and plastics industries. It is among the top ten manufacturing sector employers in 48 states and generated over $238 billion in sales and about $54 billion in annual payroll during 2012. And the wood-based panel producer is an important contributor to these results.

Profitability during the shorter and longer-term cyclical markets depends upon positioning the company and its mills. A number of ownership changes are occurring; and capacity expansion and modernization is also underway. And surprisingly there are green field projects for various panel types that appear to be oversupplied. The following are examples:

- **Plywood.** Two new State of the Art plywood facilities were completed in 2016 (one in Oregon, the other in Mississippi). These are the first greenfield plywood mills built in North America in more than twenty years.

- **OSB.** A modern, high capacity Greenfield OSB mill is nearing completion in East Texas and will become operational during the third quarter 2017.

- **Medium Density Fiberboard.** Three modern MDF plants were completed in Mexico during 2016. Several more have been announced or are in the planning stage for other sites in North America.
• **Particleboard.** Construction is underway for the world’s largest particleboard plant in Michigan, with a 2018 completion date.

In addition, we understand that other new North American plants are in various stages of planning. While the overall industry may continue to right-size to better match demand with excess supply, some of the capacity from closing inefficient mills is being replaced with highly efficient new factories. There is a renewed confidence that each segment of the wood-based industry can be profitable with the efficient user of fiber and other resources at a scale that optimizes manufacturing costs.

Industry turbulence is expected to continue as the wood-based panel industry continues to reshape its manufacturing base in North America and globally.

Confucius said about two and one-half Millennia ago, “May you live in interesting times.” The current era features wood-based panels with differing applications and technologies, rapidly expanding global demand, and the complexity of trading between nations. The interesting times are now.
ABOUT THE AUTHORS

Dr. Dick Baldwin, Dr. Fred Kurpiel, and Mr. Rich Baldwin are recognized industry specialists for structural panels, decorative panels, and engineered lumber products. They bring extensive hands-on knowledge of plywood, veneer, and engineered lumber products manufacturing and marketing to their analysis of the wood panel industry.

Within the past several years, the authors together or separately have (1) analyzed the North American panel (MDF, OSB, Particleboard) markets for a sizable European panel manufacturer looking to expand in North America, (2) researched the wood panels market (LVL, MDF, OSB, Particleboard, Plywood) in the People’s Republic of China for APA, (3) analyzed the MDF market in western North America for a proposed new facility, (4) wrote the marketing feasibility study for the Winston Plywood & Veneer mill that recently opened in Louisville, Mississippi, and (5) authored a market impact report that was used in the hardwood plywood anti-dumping complaint that certain U.S. hardwood plywood producers filed in 2013 with regard to hardwood plywood imported from China.

Dr. Richard (“Dick”) F. Baldwin recently served as President and General Manager of Winston Plywood & Veneer (Louisville MS) from April 2014 to September 2016, Omak Wood Products (Omak WA) from September 2014 to September 2015, and Chester Wood Products (Chester SC) and Moncure Plywood (Moncure NC) from April 2008 to September 2013. Notable highlights include leading the planning, financing, construction, and start-up planning for the $110 million Winston Plywood & Veneer project (one of two greenfield softwood plywood and veneer mills built in North America over the past twenty years) and preparing the Chester and Moncure businesses for their September 2013 sale to Boise Cascade for $102 million. Dr. Baldwin has authored dozens of books and publications on forest products industry management, operations, maintenance, and marketing, including Plywood and Veneer-Based Products (published in 2016).

Dr. Frederick T. Kurpiel has considerable hands-on experience in sales and marketing of wood panels (MDF, OSB, Particleboard, Plywood), upgraded products (such as Cabinetry, Doorskins, Flooring, Furniture), and engineered wood products for North American wood-products manufacturers, as well as wood production machinery for
several European suppliers of wood manufacturing equipment. While manager at the APA office in London, Fred was the lead researcher and author on several studies that analyzed the potential sale of U.S. wood panels in foreign markets; the initial efforts concentrated on plywood and later included OSB. In recent years, Dr. Kurpiel has devoted considerable effort to understanding the strategies of East Asian (China, Indonesia, Malaysia, Thailand, Vietnam) producers of wood panels.

Mr. Richard (“Rich”) W. Baldwin put together the original business plan for the Winston Plywood & Veneer facility in Louisville MS as consulting Vice President of Strategic Planning for Winston Plywood & Veneer and Omak Wood Products, periodically updated the business plan as the project started up, and participated in debt and equity capital raising efforts. Over the course of his career, Rich has put together dozens, if not hundreds, of financial models and business plans for forest products manufacturers. At various times in his career, Baldwin has served in Controller, Treasury, and Analyst positions at forest products companies in the Southeastern U.S., Northwestern U.S., Latin America, and Southeast Asia. Previously, Rich worked for well-known Wall Street firms as investment analyst for life insurance and annuity writers and reinsurers, and investment grade and high-yield retail and consumer products issuers.