SAP Thought Leadership Paper
Mill Products

Achieving Operational Excellence in an Attribute-Based Product Environment

With Innovative and Flexible Processes for Rapid Response to Customers' Needs

The Best-Run Businesses Run SAP™

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The Road Ahead

Mill products companies are going through a period of intense economic change triggered by a variety of factors, such as globalization, industry consolidation, volatility in raw material and energy prices, fierce competition, and increasingly demanding customers. These trends have resulted in constrained revenue growth and immense downward margin pressure, which highlight the importance of operational efficiency for survival.

Executive Summary

To succeed, mill products companies must adapt their existing business practices to meet the demands of a new marketplace. Typical mill products companies are characterized by a diverse set of information systems that cover a wide variety of functionality to support make-to-order, make-to-stock, and configure-to-order processes. These companies need to implement innovative and flexible manufacturing and supply chain processes that allow rapid response to changing order, market, and production environments. These processes need to be vertically integrated from the "top floor to the shop floor" as well as horizontally to business partners in the ecosystem.

The complexity of the supply chain is increased for mill products companies by the way that finished goods are defined, ordered, produced, and tracked in their plants. Manufacturers typically rely on product definitions based on attributes and characteristics and not simply on part numbers. This adds a layer of complexity to the manufacturing and supply chain process.

The best-run mill products companies have been able to leverage next-generation enterprise applications to achieve significant gains in business process efficiency. And they have been successful at turning this complexity into a strategic advantage.

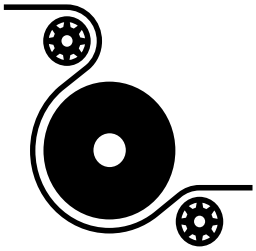
This SAP thought leadership paper discusses the key issues inherent in mill operations. It lays out the blueprint for successfully enhancing the effectiveness of a mill products value chain through the use of advanced product configuration tools.

A BLUEPRINT FOR ENHANCED VALUE CHAIN EFFECTIVENESS

Find answers to the following questions:

- What makes mill products companies unique?
- What are the key IT enablers for seamless supply chain integration?
- What best practices can improve operational excellence?

A streamlined order-to-cash solution that offers product configuration tools at a very detailed characteristic level enables mill products companies to turn yesterday's liability into today's advantage.



What Makes Mill Products Companies Unique?

Mill products companies are typically classified as a subset of process industries, yet most mill products companies have a combination of process and discrete operations. While each type of mill products company has individual product manufacturing requirements, all of them share common operational and business similarities. Products manufactured in these companies contain order-specific attributes like width, surface finish, length, chemical composition, physical and chemical tolerance limits, standard product specifications, and company or industry-specific characteristics. Mill products can be in the form of rolls, coils, bundles, and pieces, while finished mill products typically involve multiple operations including rolling, side trimming, order length cutting, and surface treatments. Overall, these companies are characterized by a high degree of variability in both products and processes. The table below shows the types of companies that SAP categorizes as mill products companies.

Supply chain management for mill products companies encompasses the planning, execution, and management of all plant activities involved in sourcing, procurement, manufacturing, and logistics management. It includes coordination and collaboration with suppliers and customers. Effectively managing the supply chain requires visibility into other plant areas, such as manufacturing orders, work in process (WIP), and material inventories. In essence, supply chain management integrates supply and demand management within and across companies. So why are the challenges for mill products companies so distinctly different than for traditional process industries or discrete manufacturers?

MILL PRODUCTS SUPPLY CHAIN CHALLENGES

If products were identified simply by a part number or material code, the number of products would be difficult to manage.

DEFINING MILL PRODUCTS

Companies that are classified by SAP as mill products companies are those that manufacture or convert metal, paper, wood, or textiles into industrial and consumer products.

Instead, products have a base set of characteristics such as grade, width, length, gauge, caliper, finish, or color. A product with these characteristics is then supplemented with additional attributes that further classify the material. A specific product could be characterized by hundreds of attributes, such as the following:

- Paper and rolled metals: quality characteristics, length, and width,
- Metal tubes: outside diameter, wall thickness, and length
- Furniture cabinet: wood type, hardware, total dimensions, and style
- Oriented strand board: thickness, strength characteristics, length, and width
- Folded carton or box: length, width, and height coupled with cut, fold, and printing characteristics

The actual values of the attributes must be known for each item through all levels of production, from the beginning of the manufacturing process to the finished product.

SAP Categories for the Mill Products Industry

Forest Products	Primary Metals	Building Materials
• Timberland • Solid wood • Plywood • Particle board	• Flat steel • Long steel • Aluminum	• Cement and concrete • Roofing material • Glass
Pulp and Paper	**Fabricated Metals and Cable**	**Textiles**
• Brown paper • Fine and specialty paper • Hygiene and newsprint paper	• Cable and wire • Metal stampings • Pipes/fittings/valves	• Yarn • Carpet • Fabric
Packaging		**Furniture**
• Paper/foil/aluminum packaging • Corrugated packaging • Folding carton		• Office furniture • Cabinets • Upholstery

Units of Measure Can Differ Throughout the Order Lifecycle
Various order quantities and measures need to be converted throughout the order-to-cash lifecycle. A given item may be sold or purchased in any one of several units of measure (for example, pounds or kilograms, feet or meters, square feet or square meters, and pieces or bundles). Manufacturing of the order, however, may be scheduled and reported in a different unit of measure. Storing material in inventory can be done in yet another unit of measure. And viewing inventory might require alternative units of measure. Transportation of products often requires volume or weight (gross or net) as a unit of measure, which can also be a different unit of measure than the one used in sales or manufacturing.

Products Being Manufactured Are Grouped into "Families"
Many products produced by a company might be the same except for one or two attributes. As a result, many mill products companies group their products into families: that is, all flat material properties, paper thicknesses, carpet dye lots, and all other groupings of products with common characteristics. In this way, similar materials can be "blocked" or "batch scheduled" to be manufactured together on a mill asset, thereby minimizing changeover time, maximizing asset efficiencies, and reducing scrap. Many mills schedule around their biggest bottleneck (for example, melt shop, recycled paper plant, rolling mill, annealing furnace, and so on). In these cases, production requests for "orders yet to come" of related products are scheduled on mill assets in advance, and customer orders are booked against that schedule as they come in. This is often called a cycle/block plan, rolling schedule, or campaign.

Effective Scheduling Is Important to Mill Productivity
Most mill products companies are capital intensive and must effectively utilize their capital equipment across different locations in order to be profitable. They need to consider external processors performing different tasks, either because there is an internal bottleneck at a work center, or certain product attributes cannot be manufactured in-house. Therefore, in addition to available-to-promise (ATP) capabilities, a key requirement is also to perform a capable-to-promise (CTP) check based on characteristic values in case manufacturing has to be triggered.

Mill scheduling is driven by numerous factors in addition to customer request dates. One of those factors is the grouping of like products. To minimize downtime due to setups, most mills sequence production either by the attributes of the material being produced (grade, shape, thickness, diameter, and so on) or by the attributes of the material from which it is being produced (for example, starting thickness versus ending thickness). So a key aspect of scheduling products at the manufacturing site is to have business logic that considers operating parameters such as machine setup time and production-related limitations by certain product characteristics – commonly referred to as characteristic-dependent planning capabilities.

Semifinished Inventories Are "Finished" into Many Variations
Mill products companies may have a huge number of end-product variations. An example is when a steel or paper company makes one semifinished grade of product with a large number of cut widths or lengths that they supply to their end customers. Again, because of the variations described above, a semifinished product may require further processing to give it its final properties – such as an additional heat treatment, paint, or coating. In some cases, the chain of property contribution must be maintained to provide product-quality certification and conformance to specifications. In summary, to manage an efficient supply chain, a company must have accurate and easy visibility into semifinished inventories by attributes to enable matching those with incoming demand characteristics for finished goods.

Inventory Is Tracked at the Piece Level
Because of the variations described above, inventory must be tracked at the piece level. To know that a piece of material in inventory has the same composition as an ordered product is not enough. It's important to know every other attribute (size, finish, and so on) to be able to fully determine if the piece is adequate to fulfill the order. This eliminates inventory mismatches such as the following:

- Bar or pipe of steel: total length required is 16' but must be in 8' increments. There is no match when inventory has 8 pieces of 2' length.
- Carpeting: total inventory available is 1,000 square feet in 3 pieces and 2 different dye lots, but the order may need the square footage to be in a single piece or from a single dye lot.
- Paper: total inventory of corrugated medium paper is 150,000 square feet, which covers demand, but the rolls are 72" wide, and the customer can only process rolls that are less than 60" wide.

Recording of used pieces for a production order or finished good is important in case of quality issues, where the capability to trace the usage of material is needed.

Inexact Quantities Are a Way of Life
In purchasing, manufacturing, and order fulfillment, exact planned order quantities are virtually never realized in

the process-oriented manufacturing steps of mill products companies. Shipment or receipt of a quantity that is slightly more or less than the ordered quantity is a normal practice. Customers often specify quantity tolerances that are acceptable to them, such as plus or minus 10%, and the producer can fulfill the order within that tolerance.

The same applies to quality differences. Attribute tolerances need to be defined to determine when a product is still considered acceptable to a customer. Matching allowed product tolerances from a sales order with existing inventory is key for minimizing inventories and is an important factor for quick response throughout the supply network. For example, if there is not an exact match in inventory, the product would have to be manufactured. However, if the customer is willing to accept a quality tolerance, existing inventory can be used.

Shipping and Receiving Logistics: A Key Factor

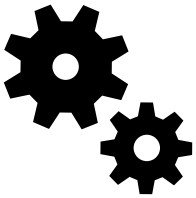
In many cases, the material being shipped or received is of considerable size and weight. Loading and unloading capacity may be limited, freight costs are significant, and shipping mistakes can be costly. Efficient carrier scheduling and proper loading are crucial to both customer service and overall profitability. When order commitment occurs, there must be a process in place that enables a determination if the order "fits" inside the shipping container. Supply chain and order management should encompass processes that maximize order quantities such that a very small amount is not left over after a container is full. This can create a major headache for sales and shipping departments.

In addition to the above, mill products companies typically are confronted with the operational challenges shown in the table below.

Operational Challenges

Operational Management in the Mills	Procurement (external/internal)	Logistics	Customer Service
Challenge: Operational costs continue to spiral upward by shrinking margins • Inability to ensure maximum asset availability and optimal utilization • Missing visibility into work in process • Inability to track manufacturing detailed costs in a timely manner	**Challenge: Supply chain is increasingly complex and difficult to manage** • Inflexibility prevents quick reaction to supply chain needs and unexpected disruptions • Unable to utilize purchasing power as one corporation • Cumbersome and time-consuming procurement processes	**Challenge: Logistics costs are a major cost driver** • Inability to determine executable transportation plans for optimal loads and multiple shipments • Missing tools to effectively collaborate with external logistic service providers • Difficulties in reducing material handling costs	**Challenge: Customers are more demanding** • Missing visibility into profitable customers and products • Inability to capture customers' requirements in an effective manner • Difficulty in determining feasible delivery dates based on customer-specific requirements
Cost increasing		Low customer satisfaction	
Mill operations			

Manufacturers typically rely on product definitions based on attributes and characteristics and not simply on part numbers. This adds a layer of complexity to the manufacturing and supply chain process.



Seamless Integration Across the Supply Chain

Given the uniqueness of mill products companies and the inherent complexity of the value chain, mill products companies are adopting multiple approaches, with attribute-based product definitions as the basis, to differentiate themselves from competitors. The techniques and tools, many of them enabled by IT, can be explained best by an example of the typical major functions of such a company, as shown in the following table.

SALES ORDER MANAGEMENT

Demand and supply planning: As always, customers are concerned with prompt delivery of orders. To improve responsiveness, some mill products companies are shifting from a pure make-to-order model toward a hybrid make-to-stock and make-to-order system so they can then match certain customer orders to existing semifinished inventory. However, choosing which semifinished products to make to stock and managing inventory are difficult tasks.

Furthermore, the preproduced semifinished inventory and, for that matter, any inventory, should be consumed with consideration of certain customer characteristics. For example, a customer with higher profitability should have priority over one that has a lower profitability potential. It is imperative to adopt an enterprise application that can consider both customer profitability and material at the attribute and characteristic level, not just at the part-number level, which is typical of many older or discrete-only solutions. A software application should be able to not only manage material information at subprocesses within the order-to-cash cycle but also should be able to support seamless integration across the value chain.

Quote and sales order management: Mills require software applications that can quickly configure quotes and orders based upon exact customer specifications. Given product variation, the configuration

Effective Order Management and Execution Processes Supported by SAP® Software

1. Sales order management	2. Production planning and execution	3. Inventory and warehouse management
• Customer inquiry and quotes • Order pricing and costing • Product characteristics and configuration • Customer available-to-promise • Internet sales • Billing	• Make-to-order or make-to-stock strategies • Capacity and resource planning • Order split and combination management • Batch and campaign management • Discrete repetitive and lean manufacturing functionality • Shop-floor integration platform	• Inventory visibility and control • Attribute-based visibility for piece matching • Workload planning and picking optimization • Radio-frequency ID and bar-code support • Resource optimization and control
4. Transportation planning and costing	**5. Complaints and returns**	**6. Analytics**
• Freight planning and tendering • Freight execution and monitoring • Freight settlement • Customs and foreign trade compliance	• Complete support for product returns • Complaint management and track and trace functionality	• Actual stock situation based on quantity and value-based criteria • Cost and profitability analysis • Comprehensive sales planning and monitoring • Full strategic enterprise management with integrated balanced scorecard • Financial planning and budgeting

engine should be able to provide complete and consistent configured items and deliver convenient cost-plus pricing that enables companies to associate profit margins with materials and labor and the overhead costs for configured items. For example, a special coated product may require an additional processing step or two, and this has to be considered when determining the cost. Companies require dynamic pricing that supports comprehensive price management of all available options at all levels. Ideally, this is a single, integrated configuration and pricing engine that provides consistency, ease of use, and control.

Customer quotations and sales orders should capture customer-specific requirements for a specific product – either finished goods that the mill products company has made or could make. If orders are contractual repeat orders, then this information can be stored and recalled easily when needed. If the order or quote is for a new product, then a "template" product can be used as the basis for generating the details. Attribute-based product definition is the key to flexibility in this area. Then it's required to have complete multilevel ATP checking of the entire configured product bill of material (BOM) and complete multilevel CTP check of configured product routing.

PRODUCTION PLANNING AND EXECUTION

Manufacturing and execution: Apart from product variations, even customer ordering patterns can vary considerably. Thus, the application should be able to:

- Efficiently manage and control inventory
- Effectively plan production across locations
- Perform the necessary quality control activities
- Trace the process all the way down to the final subprocess that meets the particular specifications

A characteristic-based production planning and scheduling application should be able to dynamically create planned or production orders with order-specific BOMs and routings. The software must be able to sequence machines considering setups and type of material using blocks or campaigns.

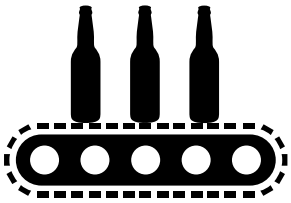
Even when the demand comes from different sales orders, the software must be able to combine the demand in two different ways. First, in the planning process, it must consume one piece in inventory stock to fulfill different demand elements. For example, a roll with specific attributes and a width of 36 inches is in inventory. Demand from a sales order fits the attributes, but requires a width of 16 inches. The software must be able to recognize the remaining 20 inches of the roll and be able to match additional demand to consume the remainder.

Secondly, during execution, the software must be able to combine different production orders or parts of production orders to be executed as one. For example, if several parts from different production orders need to be galvanized, the software must combine all the galvanizing steps into a single production order.

This technique reduces both trim loss as well as machine setup time, saving companies both time and money. In addition, it ensures that information about products, work in process, and individual sales orders is maintained throughout the order fulfillment process.

Genealogy: Mills need to be able to trace the ancestry of a manufactured piece from its purchase order receipt to the customer's delivery ticket. The tracking of individual pieces is relevant for quality management. On the one hand, quality certificates can be issued when material characteristics are recorded, for example, physical properties. On the other hand, quality issues can be traced from the finished good via multiple levels to the exact piece of raw material that was used to produce the end product. Besides the traceability of material, the production order in which a product was produced can be determined. Once a lot

The actual values of the attributes must be known for each item through all levels of production, from the beginning of the manufacturing process to the finished product.



has been identified with quality issues, it's necessary to take a bottom-up approach to identify in which production orders or finished goods these pieces were used and then take appropriate action.

INVENTORY AND WAREHOUSE MANAGEMENT

The unique nature of mills means that inventory visibility across warehouse locations is critical. The application must be able to concurrently manage and track many item attributes or specifications, such as dimensions, physical properties, shape, grade, grain direction or texture, density, and coatings. Displaying inventory in different units of measure is required for better inventory management.

For example, you need to know that there are 10 pieces in inventory with a specific weight and characteristic values of length, width, and thickness. This information is needed to make a decision (either manually or by the application itself) to allocate the right supply to a demand.

TRANSPORTATION PLANNING AND COSTING

Transportation management: From the time the order is received, you have to effectively plan, execute, and manage your logistic operations to meet customers' expectations. The application must be able to simplify and enhance your transportation processes by enabling you to automatically route and rate the order, collaborate with your carriers, generate documentation, coordinate with the warehouse, and track every step.

Logistics and fulfillment: Functionality to track inventory and pick, pack, and ship the configured product once it is purchased or produced should be efficient and easy to use. Furthermore, each customer usually wants to be invoiced in their preferred unit of measure, such as pieces, pounds, hundred weight, lot, kilo, and so on. The application should be able to support this requirement and convert these units of measure to the customer's preferred unit of measure based on the material's characteristics, including specific weight or density.

COMPLAINTS AND RETURNS

Mill products companies must consider that, due to quality problems or accidents in shipping, there will be returns and requests for credits. Mill products companies must be able to handle complaints and returns efficiently and be able to look at patterns that show larger problems, such as systemic quality issues and mismatches of manufacturing capabilities to requested products. For example, a mill products company must be able to determine if a single batch of material is defective, if there are multiple defective batches, and if problems are due to quality or manufacturing (or both).

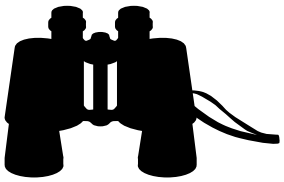
Usually several departments are involved in managing complaints. Different employees are responsible for recording an incoming complaint, investigating the source of the problem, and making a decision to accept or reject a complaint. If the complaint is accepted, another employee may be responsible for issuing a credit or triggering the delivery of a replacement product. A seamless integrated process supported by workflow enables fast reaction to and efficient handling of complaints.

ANALYTICS

Complete, detailed analysis of all logistic activities for configured products provides the information that is needed to monitor all aspects of the order-to-cash cycle. This includes financial information about detailed product costing.

In addition, you can use network-wide visibility across your extended supply chain

With visibility across the entire supply chain network, planners and key decision makers can perform strategic and tactical business planning.



to perform strategic as well as day-to-day planning. You can monitor and analyze the performance of the extended supply chain using predefined key performance indicators (KPIs).

With visibility across the entire supply chain network, planners and key decision makers can perform strategic and tactical business planning. They can test scenarios to determine how the supply chain network can address changes in the market, the business, or customer demand.

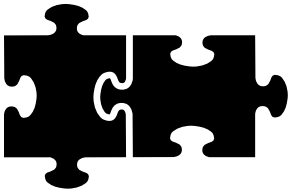
You can define, select, and monitor KPIs to get an integrated, comprehensive view of performance across the supply chain. And you can use predefined KPIs based on the supply chain operations reference model, which includes sourcing, planning, production, distribution, and returns processes.

A complete, integrated attribute-based system as described above will provide the improved visibility and control of operations shown in the following table.

Operational Excellence Through Visibility and Control with SAP® Solutions

Operational Management in the Mills	Procurement (external/internal)	Logistics	Customer Service
Solution: **Optimize production schedule and gain visibility into costs** • Improve on-time delivery with optimized manufacturing capacity • Reduce resource and unproductive labor consumption • Gain clear and timely visibility into cost structure of products produced	**Solution:** **Gain visibility into supply chain events and costs** • Automate operational processes to reduce purchasing errors, eliminate manual tasks, and avoid maverick buying • Build collaborative supplier relationships and integrate suppliers into your procurement processes • Accelerate procurement order and invoicing cycle times	**Solution:** **Reduce logistics costs with flexible, integrated processes** • Increase perfect order fulfillment with integrated planning and logistics • Reduce operational expenses and transportation spend • Improve warehouse efficiency with automated processes and tighter controls	**Solution:** **Achieve superior customer service and profitability** • Have relevant, up-to-date customer and product information at your fingertips • Easily capture customer requirements and provide feasible delivery dates and pricing information • Analyze your pipeline, sales, quota, and other KPIs to see where corrective actions are required
Cost reduction		Increasing customer satisfaction	
Mill operations			

Best-run mill products companies have been able to successfully leverage next-generation enterprise applications and resolve the integrated planning conundrum.



Using Best Practices to Improve Operations

BLUEPRINT FOR SUCCESS

Success lies in ensuring that all six steps of the order management and execution process shown in the following table are integrated and seamless. Attribute-based product definition and visibility lie at the core of that success.

However, total value potential can be achieved only by seamlessly integrating all critical business processes. The table below shows what can result from the implementation of an integrated software solution that supports lifecycle data management, supply chain planning, customer relationship management, enterprise asset management, and procure to pay. Mill products companies can exceed industry-average performance and achieve best-in-class status.

THE ROAD AHEAD

The right enterprise application leverages sophisticated attribute-based functionality that is integrated with the full range of planning and execution processes, including planning, pricing, production scheduling and execution, inventory, transportation, billing, and profitability analysis. Best-run mill products companies have been able to successfully leverage next-generation enterprise applications and resolve the integrated planning conundrum. They have achieved significant gains in business process efficiency and successfully turned complexity into a strategic advantage. Order management and execution software supports the business processes of sales order processing, production planning and execution, warehouse and inventory management, transportation planning, returns, and analytics. Success is powered by attribute-based visibility at the item level, which can streamline the order management and execution process.

Building on its years of experience with mill products companies, SAP understands what makes mill products companies unique. SAP and its partner ecosystem deliver the key IT enablers for smooth and effective supply chain integration. In addition, SAP for Mill Products solutions are based on industry best practices. You can enhance the effectiveness of your value chain through the use of advanced software solutions from SAP.

FOR MORE INFORMATION

To learn more about how SAP can help your company become a best-in-class enterprise, call your SAP representative today or visit us on the Web at www.sap.com/industries/mill-products/index.epx.

Becoming a Best-in-Class Mill Products Company

Key Performance Indicators	Average	Best in Class
On-time delivery (order date)	89.7%	**99.1%**
On-time delivery (confirmed date)	92.5%	**99.3%**
Delivery service levels	60.0%	**97.2%**
Order fulfillment lead time (days)	6.2	**1.3**
Inventory days of supply (days)	79.0	**35.8**
Cash-to-cash cycle times (days)	97.3	**37.3**
Warehouse costs (% of turnover)	2.0%	**0.6%**
Asset turns	2.1	**5.8**

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