

Impact of Formula-Based ERP Applications on Chemical Manufacturers

Executive Summary

Whether you're in the process of re-evaluating your existing ERP solution or looking to replace your spreadsheets, it's important to focus your search on applications with strong capabilities to support your unique requirements, so you don't have to change the way your business operates.

This practical guide links the unique business processes of the chemical industry to specific software capabilities available in formula based ERP solutions. Case study references provide insight into the capabilities needed to manage by-products and co-products, variability of ingredients, and finished products and processes. It also addresses how the right ERP solution can significantly improve product costing, production predictability, and scalability, as well as compliance issues related to traceability and MSDS.

Whether your process includes distillation, refinement, recovery, or production, this ERP essentials guide will help you choose a solution that is right for your needs. A checklist of specific capabilities is also included for use during the evaluation process.

Introduction

Today's chemical industry is faced with a multitude of challenges, including rising costs of raw materials and energy, price and margin pressure, global competition, product innovation and differentiation, and increasing risk and regulation. What's more, chemical companies must be nimble enough to take advantage of opportunities in the global marketplace, while being able to address changing customer dynamics and manage the intricacies of a tight economy.

An ERP solution for the chemical industry needs to address its unique manufacturing and financial businesses processes, including manufacturing formulation, costing and quality control, materials and production planning, maintenance management, accounting, budgeting, planning, and forecasting.

With the right solution in place, chemical companies can sustain or increase customer satisfaction; improve profitability; ensure high quality, consistency and efficiency; and overcome the limitations of slow, error-prone manufacturing processes.

Getting Started

Most ERP solutions support the needs of accounting and financial functions, but when it comes to purchasing, inventory, manufacturing and sales, they don't always meet the needs of a chemical manufacturer. Why? Most "standard" ERP solutions were designed for discrete manufacturing (typically physical products that go directly to businesses or consumers, or are used as assemblies in other products) instead of process manufacturing (using a formula using ingredients to create a bulk output). If you are investing in an ERP solution, you'll want to choose an application with best practices for your industry built into the solution, without adding extra cost and implementation effort.

This practical guide examines several key areas of process manufacturing in terms of key ERP functional capabilities, data model characteristics, and enabling technologies, specifically:

- The inventory, accountability, and management of common ingredients
- The ability to predict yields, scale production, and accurately cost products
- The effect of variable product characteristics and inventory attributes, such as package weights, expiration dates, and multiple units of measure, on inventory management, order management, production scheduling, manufacturing, QC management and product costing
- The impact of the ERP architecture and design on the application's functionality and maintenance
- The ability to track and trace all products as well as packaging materials

At the end of this document, a summary of these critical areas is provided as a functional questionnaire to be used during your software vendor's product demonstrations. As you select the right fit solution for your company, you should also consider a software provider's industry experience, expertise, and support. This is an important consideration that will impact your ERP implementation, and it is as important as the product architecture and capabilities.

Manage Variability

Variability impacts the consistency and quality of finished products. A good indication that an ERP application is capable of managing product variability is that it supports an unlimited number of product characteristics for both raw material and finished products. It should support user-definable characteristics as well as industry standard characteristics, such as pH, potency, moisture content, and expiration date.

Formulation and process control are the primary concerns in chemical manufacturing operations, where variability creates significant challenges for process specifications. Raw materials are purchased and finished goods are produced in a variety of quantities, potencies, and qualities. The ERP application must be able to identify these variability's, in addition to the fluctuating cost of both raw materials and packaging materials, in order to adjust production jobs.

Managing variability starts with a purchase order for raw material with specific product characteristics. At the time of receipt, these raw materials are inspected and validated against a set of tolerances. Once received, lot numbers can be assigned to raw material inventory so that it can be tracked throughout the manufacturing process.

Chemical manufacturers are often required to deliver finished products to customers that meet certain requirements. A raw material might meet one process specification, but it might not meet another. An ERP solution can provide full visibility into available raw materials inventory and their product characteristics, so that manufacturers can deliver products that meet customer requirements.

An ERP application based on formulas can be used to manage all raw materials, packaging materials, and multiple finished goods, while delivering a high level of predictability and repeatability. This formula should define the manufacturing, yield, quality, routing and costing processes. Variable product characteristics, such as potency grade, pH, or moisture content, determine the ingredient proportions and equipment settings in certain process stages.

To manage this variability during production, the ERP application should allow manufacturers to make adjustments to the base formula specifications in terms of ingredient proportions and equipment settings, without affecting the definition of the original "base" specifications. Variations of a formula specification can also account for differences between plants, shifts, production lines and equipment, as well as customer requirements, such as private label products.

Improve Predictability of Scaled Production

Formula specifications are designed to produce one or more finished products in bulk quantities. A batch run is expected to produce a quantity of finished products within a given range in a certain time period. For example, a chemical reaction within 10 liters of a solution takes the same time as 50 liters of the same solution in the same vessel. When batch runs are scaled up or down, the batch quantity ranges and the production times follow a "step" function rather than a linear function.

When a chemical manufacturer scales production, the ERP application should be able to predict finished product yields, and deliver consistent results, in terms of quantity and quality.

Deliver Accurate Product Costing

Accounting for all material and operational costs in the manufacturing process is one of the biggest challenges facing many manufacturers. Without accurate and up-to-date cost information, they cannot make informed decisions on key business issues, such as new product pricing strategies. A manufacturer needs to be able to link finished products to customer volume discounts, promotional rebates and incentives, in addition to the cost of raw materials, to determine profitability.

An ERP application should be able to capture, assign and compare actual and standard costs for all finished products. Waste products typically have the cost of disposal charged back to the primary product. Unexpected off-spec products can be considered as waste or stored and held in quality control status, then sold for a given market value. By-products are typically assigned a straight cost, but in situations where the by-products, such as reclaimed solvents, are available for sales, their revenue can be credited back to the primary product. Co-products are typically assigned a cost, based on some percentage in the job or a specific product characteristic such as quality, weight, potency, or market value. By capturing actual versus standard costs for co-products and by-products, chemical manufacturers are able to optimize their manufacturing processes.

Flexible Specifications Support Multiple Processes

For discrete manufacturers, assembly and packaging are the standard processes that are executed in an ERP application based upon a multi-level bill of materials and routing instructions.

It's much more complicated in the chemical industry, when different products are being processed to meet different customer specifications. For example, a cleaning agent might be produced in barrels for one customer or packaged in plastic bottles for another. Or the end product might include an added scent for one customer and without for another. In addition, there may be continuous flow processes linked to batch processes that need to be managed and kept in synch.

The ERP application should be able to employ formula specifications to manage processing and packaging. By linking production and packaging specifications, but maintaining them separately, chemical manufacturers are able to:

- Produce different finished products that are similarly packaged
- Produce product for future private labeling
- Produce and track intermediates (such as a cleaning agent packaged in a barrel that will be dispensed into smaller containers after color and scent is added)

Flexible formulas allow chemical manufacturers to model their processes in a series of controllable and repeatable process stages.

Example

Summit Industrial Products, a synthetic lubricant manufacturer and member of the Kluber Group, offers private labeling to its customers. Gear lubricants, hydraulic fluids and compressor lubricants are blended and stored in large volumes in tanks. The fluids are packed out based on color of container, size of container, and label on the container. “We can have an infinite number of private labels associated with core part code. For instance, SH-46 is our lead compressor lubricant product. I may have 200 private labels associated with that. The core formula is still the same, but it gives me the ability to name it something unique in the system, to track it that way, to give it a unique color of pail, unique unit of measure - and other unique requirements that the customer requires. Some customers may have three or four different private labels on the same product.”

Kelly Starr

EVP - Finance and Administration, Summit Industrial Products

Manage Multiple Units of Measure

Multiple units of measure are used in many chemical business processes: goods may be purchased in one unit of measure, stocked in inventory in another, issued in finished goods in one more, then sold in another. The ERP application should allow process managers to manage inventory in terms of bulk units or measure (gallons or pounds), packaging units (pails or large drums) and random attributed (variable weights and potencies) at the same time. Inventory can be costed by potency units, solid percentage, or any other unit.

Product variability plays a role in unit of measure conversions. Process-oriented ERP applications typically support user-defined and automatic UOM conversions (liquids to solids, gases to liquids) that are initiated within the manufacturing process, as well as from specific changes in inventory attributes.

From purchasing through inventory, order management through shipping, the ability to work with multiple UOMs improves both performance and customer service.

Example

SI Group (formerly Schenectady International, Inc.), a privately-held, global chemical company, discovered a significant difference in the number of data model tables when moving from a leading ERP software application to an industry-specific ERP application. “Our first ERP solution had approximately 12,000 database tables that were difficult to decipher, whereas our current ERP solution has approximately 2,500 tables that have intuitive names. Through simplification and focus, SI now has a robust, functional system that has greatly streamlined global deployment and maintenance of the ERP system.”

Allen Look,

Director of Global Information Technology, SI Group

Manage Inventory Efficiently Thru Expiration Date Tracking

Managing expiration dates can be an on-going challenge for chemical manufacturers, as some substances may lose their effectiveness after a certain period of time. An ERP solution can help improve inventory management by offering better shelf-life control. It should offer basic inventory rotation methods (e.g. first in, first out (FIFO), last in, first out (LIFO), and first expiration/first out (FEFO)) when selecting ingredients for production based on the supplier or packer production dates. These selection criteria can also be carried forward when selecting product to ship to customers, based upon order requirements.

By ensuring that the best rotation methods and quality standards are followed during the order fulfillment process, process-oriented ERP applications can significantly reduce customer charge-backs, prevent transactions for expired lots, and notify users when inventory is getting close to expiration. The result is improved product quality, greater customer satisfaction, and less waste from expired inventory.

Deliver Higher Quality Goods

When it comes to making quality decisions in process manufacturing, a higher degree of variability often results in a range of acceptability. An ERP application can help manufacturers to track the quality conditions of raw materials and finished goods and make better decisions about product quality. Greater variability requires more robust quality management capabilities, as well as lot management capabilities.

The ERP applications should support the definition of quality checks of raw materials and finished goods in the formula specification to ensure that they are executed in proper sequence in a certain process stage. By collecting and analyzing quality data, a manufacturer can identify problems with raw materials, finished goods, and equipment.

To reduce quality issues tied to production startup losses, manufacturing processes, and scrap and rework activities, manufacturers need real-time visibility into overall plant performance, including product quality and equipment performance trends. By collecting relevant real-time data from plant operators and existing automation, real-time performance management measures rates, yields, utilization, overall equipment effectiveness, and per-unit cost data. When this real-time performance data is evaluated, performance issues can quickly be identified so that repetitive problems can be eliminated and issues can be resolved.

Expedite Track and Trace

Traceability is a crucial ERP function that is responsible for tracing and tracking the lineage of all raw materials and finished products, based on their characteristics and lot numbers. Due to the batch run quantities produced in process manufacturing, the ERP application should be able to trace and track an ingredient even if it is only present in miniscule amounts. For example, if a volatile organic compound (VOC) is included in the finished product, it must be tracked in compliance with government regulations, as well as to facilitate recalls if an issue results. An example includes certain chemicals in fertilizers that are explosive or highly flammable.

The ERP application should be optimized for full lot traceability from raw materials through production, tracking finished goods from supplier invoice to customer invoice, and identifying the raw materials and resources that produced the finished products. As customers and regulatory agencies require process manufacturers to deliver 100% accurate lot traceability within a short period of time, bi-directional lot tracing allows manufacturers to respond to product recalls in minutes, rather than days.

An ERP application simplifies the procedures necessary to demonstrate compliance to customers and regulators. Thorough records of quality management and lot maintenance should be easily accessible, as well as an audit trail of changes that occur during the process.

Minimize System Configuration

Look for an ERP application that includes predefined labels reflecting standard terminology in the chemical industry, extending from label naming conventions to database table and field naming conventions. Chemical manufacturers should expect to see formulas, ingredients, co-products and by-product naming conventions reflected in the labels used in screen transactions and reports. These predefined labels can reduce the initial system configuration and ongoing maintenance costs, as well as reduce the risks involved in performing the activities.

Field level definition is commonly overlooked when investigating an ERP application. For example, tracking a very miniscule or trace amount of an ingredient in a finished product requires certain data fields to be defined with the right number of decimals, such as specific gravity or MSDS on file.

Summary

If you're a chemical manufacturer searching for the right ERP application or are in the process of re-evaluating your current ERP application, you should focus on applications with a strong process manufacturing foundation that easily manages the unique requirements of your industry.

By investigating available ERP applications, you will discover that a formula-based ERP application can successfully manage the variability of products and processes, accurately account for all raw material and finished products, and significantly improve product costing, production predictability, and scalability far better than a generic or discrete-oriented application. Designed with the right baseline functional capabilities, data model structures and enabling technologies, a formula-based ERP application can support your business requirements with minimal customization and consulting services. A focused solution will conform to your business rather than requiring you to change your business to use it, while reducing operating costs and improving customer service levels.

ERP Checklist for the Chemical Industry

To help you evaluate and select the ERP application that is right for your business, use this checklist to create your own side-by-side comparison of ERP applications.

Improving production through formula management

- When stages within a formula are linked together, can the output of one stage become the input for the next stage, without having to perform an intermediate inventory transaction or define an unnecessary intermediate product?

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- How does the system handle “conversion,” where the actual output is converted from the planned/scheduled output?
 - Can yield be measured by operation and across the process?
 - Does the system support different units of measure throughout the process specification (e.g., variable weights, units, pounds, cases, barrels)?
 - Does the system support input-driven (for supply) as well as output-driven (for demand) process specifications?

Managing the variable characteristics of products

- Can the system update actual product characteristics based upon QC values recorded during manufacturing?
- Can the system accept or modify formulas based on actual values, such as moisture content or potency?
- Reducing customer chargebacks and inventory write-offs with expiration date management
- Can distribution days (minimum days of shelf life that must remain when product is shipped) be defined separately from standard shelf life?
- Can the system net the quantity of product reaching expiration from available quantity if demand does not consume all available inventory of that lot/batch by its expiration date?

Improving product costing

- Can actual costs be tracked and compared to standard or estimate cost?
- Do you have options for standard cost, weighted average cost or actual cost by lot?
- How are costs for co-products and by-products handled?
- Can the estimated cost of a process specification be compared with the actual cost of a job/batch?
- Can future costs be used to provide what-if comparisons of total cost?
- Can costs be date driven?

Managing multiple units of measure simultaneously

- Does the system support different units of measure for receiving, producing, storing, and selling the same item?
- Can the system support catch weights with verification to minimum and maximum catch weight?
- Can the system support net weight or standard weight products (and track give-away)?

Meeting regulatory compliance

- Does the system provide adequate record keeping to meet FDA and customer requirements?
- Can product characteristics be used to force or limit the selection of specific lots/batches based on matching the actual characteristic values to a specific customer request?
- Does the solution have eSignature capabilities? Does it support necessary validation? Is ePedigree supported?

Accelerating product recalls through lot traceability

- Does the system maintain full forward and backward lot/batch integrity when product is converted during manufacturing, without losing any audit or trace linkages?
- Are lots tracked at every step in the process (from receiving to manufacturing to shipping), capturing materials, production resources, people, processes, steps, and time?
- Is the traceability program capable of handling recalls and mock recalls in minutes instead of hours?

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