

Operations Management and the Integrated Manufacturing Facility

This white paper provides a summary of the business value for investing in software systems to automate manufacturing operations within the scope of ISA95 level 3.

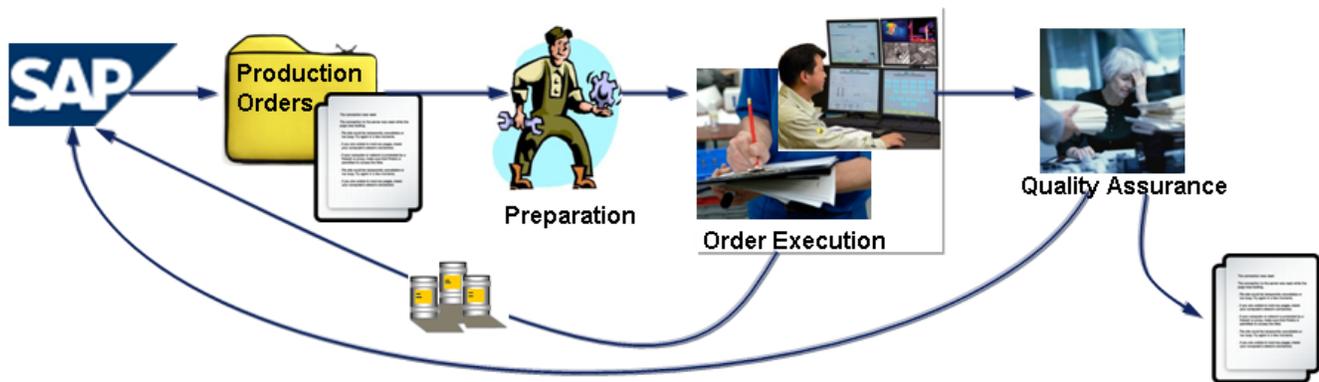


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Introduction

Emerson has extended its award winning PlantWeb digital architecture to include manufacturing operations management capabilities with its Syncade Smart Operations Management Suite. The purpose of this white paper is to describe the need, application, and value of using IT software solutions to manage production, material, and quality operations and the value of integrating process control and IT systems to improve manufacturing agility, efficiency and right first time performance.

Through the application of IT systems that bridge between the ERP and the process control system, operations can be improved that result in improved capacity utilization, lower cost of manufacturing, reduced inventory, and lower cost of quality.

Going Beyond Process Control to Gain Manufacturing Operations Efficiency

In today's market, process manufacturers are experiencing relentless pressure to improve operations. The challenges being experienced include globalization that are forcing facilities in developed economies to compete with capacity from developing economies. Customers continue to increase expectations for quality and on time delivery. As the workforce ages and retires, experience is lost, and government regulation from OSHA, FDA, EPA, and others seems to bring an ever increasing burden for compliance.

These challenges have process manufacturers looking for ways to increase efficiency and improve manufacturing performance. In order to take the next step in process manufacturing efficiency it will be necessary to go beyond the basics of good process control. World class process manufacturers are now investing in IT systems for manufacturing operations management to address the entire supply chain requirements including production, material, and quality operations.

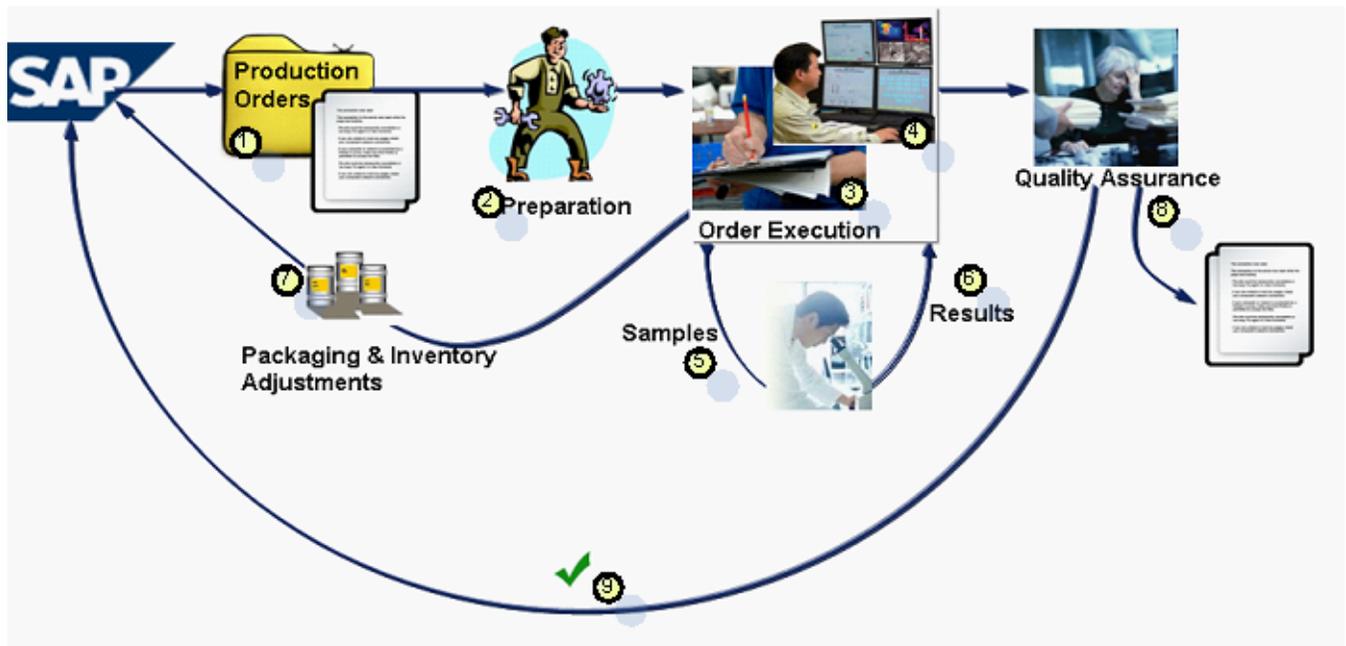
In the figure below, the production process is illustrated from planning to shipment. The ERP is the production and resource planning domain. This is the front end of the process that turns customer demand into production.

The output of production planning are production orders (1). Production orders typically includes:

- Intermediate and finished goods products to be made
- When to make the products
- How much to make
- Equipment and materials that should be used
- Procedures to follow to make the products
- Quality specifications

There may be many different production orders that need to be prepared including intermediates as well as the final product.

Figure 1 Process Production from Planning Shipments



After the production orders are created, in many cases there is preparation to be completed prior to executing the order (2). Equipment may need to be reconfigured or cleaned. Materials may need to be staged such as a change in catalyst or addition of additives; equipment integrity may need to be verified such as pressure checks, calibration checks and filter expirations; or it may be necessary to verify training records of the people assigned to do the work if you are in a regulated industry.

After the preparations is complete, the order can now be executed. When executing an order, many things need to be done and coordinated. The process control system (4) needs to be put in the correct mode of operations with the correct operating parameters, automated sequences may be required to be executed from the control systems, manual procedures (3) need to be performed such as charging materials, material calculations, or manually opening values that are not automated. Operator rounds may be required to collect process information, in regulated industries, signatures may be required. Samples (5) need to be taken and delivered to the lab, lab results (6) have to come back to the plant floor for use in calculations, processing decisions, and quality documentation. If these plant floor activities are not properly coordinated and correctly performed a significant impact to quality, yield, productivity, or safety could be experienced.

Once process manufacturing is completed, the material flow may need to go through packaging and finally material accounting needs to be performed so that the ERP inventory is updated to reflect raw material consumption, and the creation of finished goods (7).

Before production can be released for shipment, Quality Assurance need to gather all the relevant quality and production records and review all critical process parameters to verify they are within the required specifications (8). Information may be incomplete and QA may need to go back to manufacturing and the lab to get the required information. This process can take from days, weeks, and in rare cases months to complete. All the while, material is waiting in an unreleased status and cannot be shipped. When QA approval is completed, the production is released and approved for shipment (9).

The operations described above are operations that are not typically automated with instrumented equipment but rather depend upon people to execute by following procedures and recording the results of the procedures in documentation. Significant opportunities to increase manufacturing performance may be obtained to transitioning these operations from paper driven activities to software system driven transactions.

Inefficiency of Paper Operations

Controls for the execution of manual procedures have been traditionally performed with the definition of the work process being contained in Standard Operating Procedure (SOP) documents and the performance of these operations recorded on paper forms as part of the production record. Managing production, quality, material, and maintenance operations with paper procedures and manually created production records limits manufacturing efficiency for the following reasons:

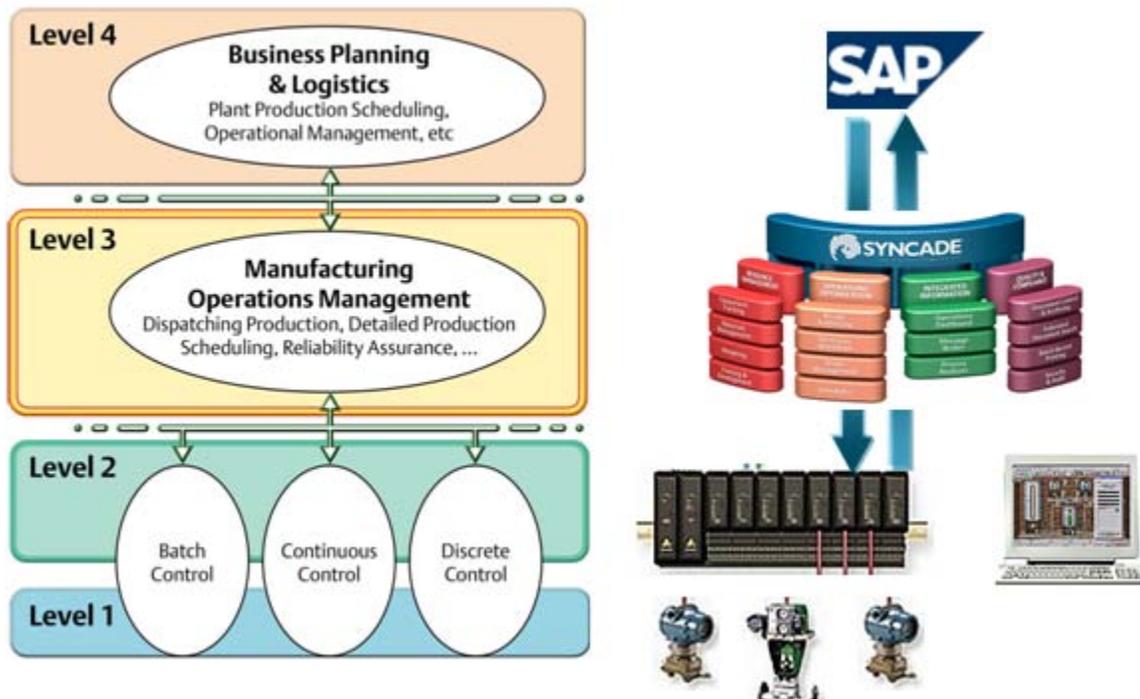
Table 1 Paper Inefficiency Vs. Business Impact

Paper Inefficiency	Business Impact
Coordination of people and information	Reduce productivity, cause delays
Execution of paper based procedures	Operator error impacts quality, capacity utilization and productivity
Paper documentation of production data	Error prone, loss of productivity, typically needs to be transcribed between systems, results in inaccurate recording of production information
Paper based material accounting with post production entry into ERP Inventory System	Inaccurate inventory results from latent data entry and data entry errors; can result in either excess inventory or inventory shortages
Transcribing information between computerized systems and paper documentation	Error prone, lost productivity
Paper based tracking of production status	Limited visibility of production status results in lower productivity since time is consumed creating shift reports to keep everyone updated and less efficient production planning can impact capacity utilization
Paper based production tracking can result in poor coordination of the production process	Production delays reduce capacity utilization
Paper based maintenance management	Delays in work order execution, inability to implement predictive maintenance
Asset performance information is collected in paper log books	High maintenance costs resulting from the inability to analyze asset performance
Paper based quality management slows production release for shipment	Excess inventory is needed to meet customer shipments
Personnel qualification management	Productivity, compliance, and quality
Material usage on the plant floor is documented on paper	Post production entry of material use into ERP is error prone and adds latency to accurate inventory management
Actual time to perform process operations is difficult to document	Use of “standard labor” hours for labor accounting results in inaccurate understanding of labor costs.

ISA95, a Framework for Integrated Operations

World class process manufacturing companies are transforming from inefficient paper based operations management to highly efficient, coordinated, integrated, computer based production, materials, and quality management. This transformation is enabled by investing in Operations Management systems and integrating these systems with the other strategic manufacturing systems. ISA95 (www.isa-5.com/subpages/technology/isa-95.php) defines a systems architecture standard to provide guidance for the implementation of a digital manufacturing by implementing integrated software systems to eliminate paper based processes. This standard defines manufacturing systems level 0 to level 4. Figure 2 provides a brief summary of the ISA95 manufacturing systems model and the typical type of system available for each level. Level 0 references the process, level 1 references instrumentation, level 2 references control and supervision, and level 4 references the business planning and logistics. Level 3 is defined for Manufacturing Operations Management and represents the least automated area of the ISA95 model and is managed by paper in many process facilities.

Figure 2 ISA95 Model and Systems Reference



Process manufacturers have for the most part invested in electronic systems for process measurement, control, supervision, and the enterprise resource planning functions. Investing in electronic systems for level 3, manufacturing operations management, has been lagging largely due to the fact that the systems available for meeting the Operations Management functions have required a large degree of customization and have been costly to implement and own. This has now changed with the availability of cost effective, configurable, web based, standard product solutions for Operations Management. Emerson’s product for operations management is Syncade Smart Operations Management Suite. (www.emersonprocess.com/syncade)

The process industries are now transforming from paper based to electronically executed manufacturing operations in order to increase production efficiency and quality. Configurable solutions are now available to manage process plant production, quality and maintenance activities. Syncade Smart Operations Management Suite provides software to manage process manufacturing operations and functions complimentary to the process control layers (ISA95 levels 1&2), providing solutions for material tracking, order management, manufacturing procedure workflow, systems integration and data visualization, and document management.

Figure 3 Syncade Smart Operations Management Suite Applications



In addition, the changes to the economics of operations management software, the advent of wireless plant network solutions have also made implementation more practical. Many operations are performed by workers who are in the plant at the process unit. The mobile nature of this work has made the use of a paper on a clipboard the traditional medium for controlling the execution and documentation of plant floor operations. Emerson now offers Wireless Plant Networks (see www.emersonprocess.com/smartwireless) that enable workers who are mobile within the process plant to perform and document work procedures interactively with a wireless terminal.

Figure 4 Emerson Wireless Mobile Worker Device



The wireless mobile worker terminal is well suited for industrial environments and is available with a class 1 Div II electrical classification and can include bar code scanners for use with the Operations Management software.

Why Invest in Electronic Operations Management?

Potential areas of value realized from investing in operations management systems are listed in table 1. Reduced operator errors are realized through electronic guidance in the performance of manufacturing procedures as well as reductions in manual data entry and operator calculations. Better production coordination occurs through the integration of ERP, lab, plant floor automation, manual procedures, documentation and maintenance systems.

Better quality can be expected from reducing errors and the cost of quality is reduced from fewer deviation investigations and exception reporting. Because quality is improved, and less errors are made, faster quality assurance review and approval can be expected.

Better right first time rates increase productivity and reduce waste and rework. Higher capacity utilization is realized through increased visibility to the plant floor and improved cycle times. Working capital requirements are reduced because of increased accuracy in material accounting, reduced inventory requirements, shorter product release times, and automated transactions for raw material consumption and finished good creation.

Finally, plants can expect improved compliance and better plant wide visibility to production status.

The following summarizes the benefits of electronic manufacturing operations management:

- Reduced Operator Errors
- Better Production Coordination
- Better Inventory Management
- Faster Cycle Times
- Increased Productivity
- Higher Capacity Utilization
- Reduced Working Capital
- Improved Right First Time Rates
- Less Waste And Rework
- Better Quality, Lower Cost of Quality
- Improved Compliance

ERP to Plant Floor Integration

Many organizations are putting effort into integrating the plant floor with their ERP systems. The reason for this is that it enables efficient coordination of the manufacturing capacity with the production demand. Integration between the ERP and plant floor enables agile manufacturing responses to quickly and efficiently change the production on the plant floor to meet the needs of the business. ERP to Plant floor integration enables a variety of capability including:

Table 2 Capability vs Business value for ERP to Plant Floor Integration

Capability	Business Value
Automatically driving a production order from the planning domain into the manufacturing domain	Faster response to business demands, better control over finished goods inventory
Automatic changes to plant floor equipment operation including cleaning, setup, and operating conditions needed to produce the planned production lot	Better capacity utilization, faster change over to new operating conditions, less off spec production
Planning and scheduling capability has real time updates on the production status for production lots in progress	Improves planning, production release, and capacity utilization
Real time and automatic updates for ERP inventory based on plant floor material usage	More accurate inventory management results in better use of working capital
Plant floor integration enables uploading of actual start and finish times for processing steps into the ERP	Enables labor accounting to be based on actual labor rather than standard labor hours
ERP data entry is automated from the plant floor systems	Improves productivity by eliminating post production transcribing of data from paper records into the ERP and eliminates data entry errors

Production Management

The ERP is where supply chain planning determines how the production capacity needs to be applied to meet customer demand. Its Syncade’s role to enable the production capacity to quickly and efficiently respond to changes in product demand or feed stocks.

The ERP issues a production order and is received by Syncade which provides plant floor order management. The Syncade order contains all information needed to make the product. The Syncade order can initiate and coordinate any required changes to the control system such as initiating startup sequences, operating condition changes, or starting batches. If there are any manual procedures that need to be coordinated with the automated procedures, Syncade will create the workflows that guide the operator through the performance of the manual tasks and keep these coordinated with the rest of the operations.

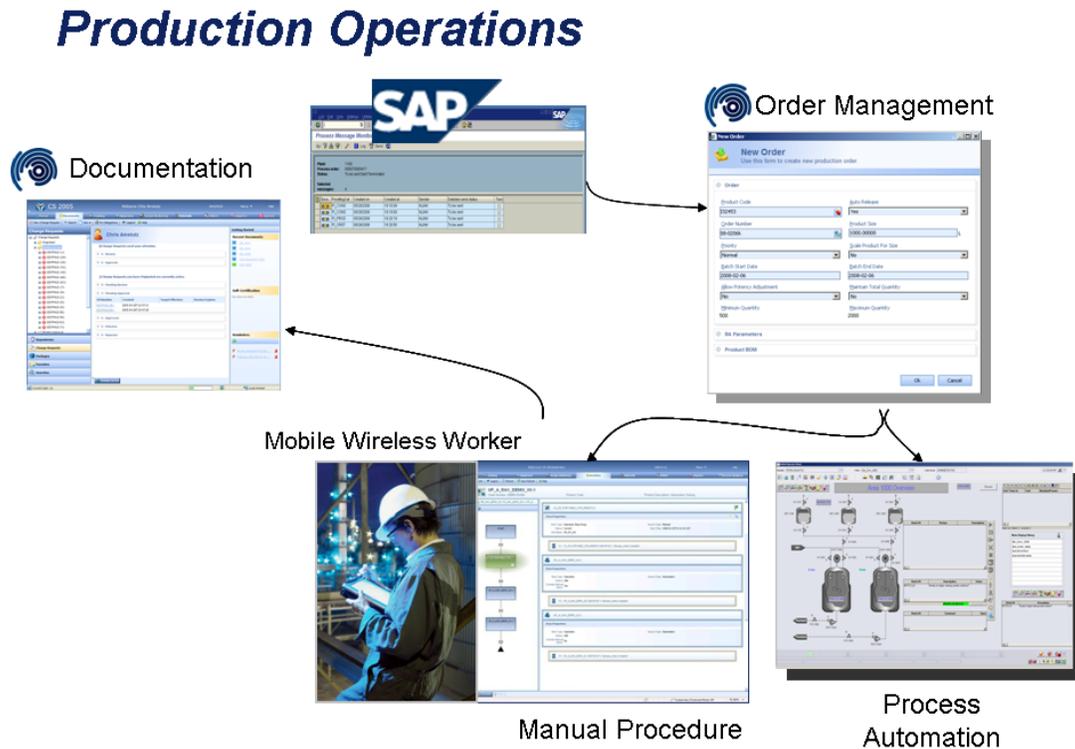
Wireless mobile worker terminals may be used to perform the workflow driven manual procedures. Syncade assures operations are performed completely, accurately, and right first time. When production operations are complete, the production record can automatically be generated, routed for approval and archiving.

Using Syncade to manage production operations provides increased agility by enabling faster transitions from planning to order execution. Whether it's a product grade change, changing batch production, or changing to feed stocks, faster coordination of change over activities increases capacity utilization.

Syncade Suite makes the production operations more efficient by eliminating the paperwork needed to create and track production orders, eliminating the time and effort needed to type operating parameters from the production orders into the control system, and eliminating the work needed to write process information into production records.

Right first time benefits can provide enormous value. Syncade Suite increases right first time performance with workflows that enforce the performance of procedures, the collection of data and signatures and eliminate data entry errors.

Figure 5 Syncade Application for Production Operations

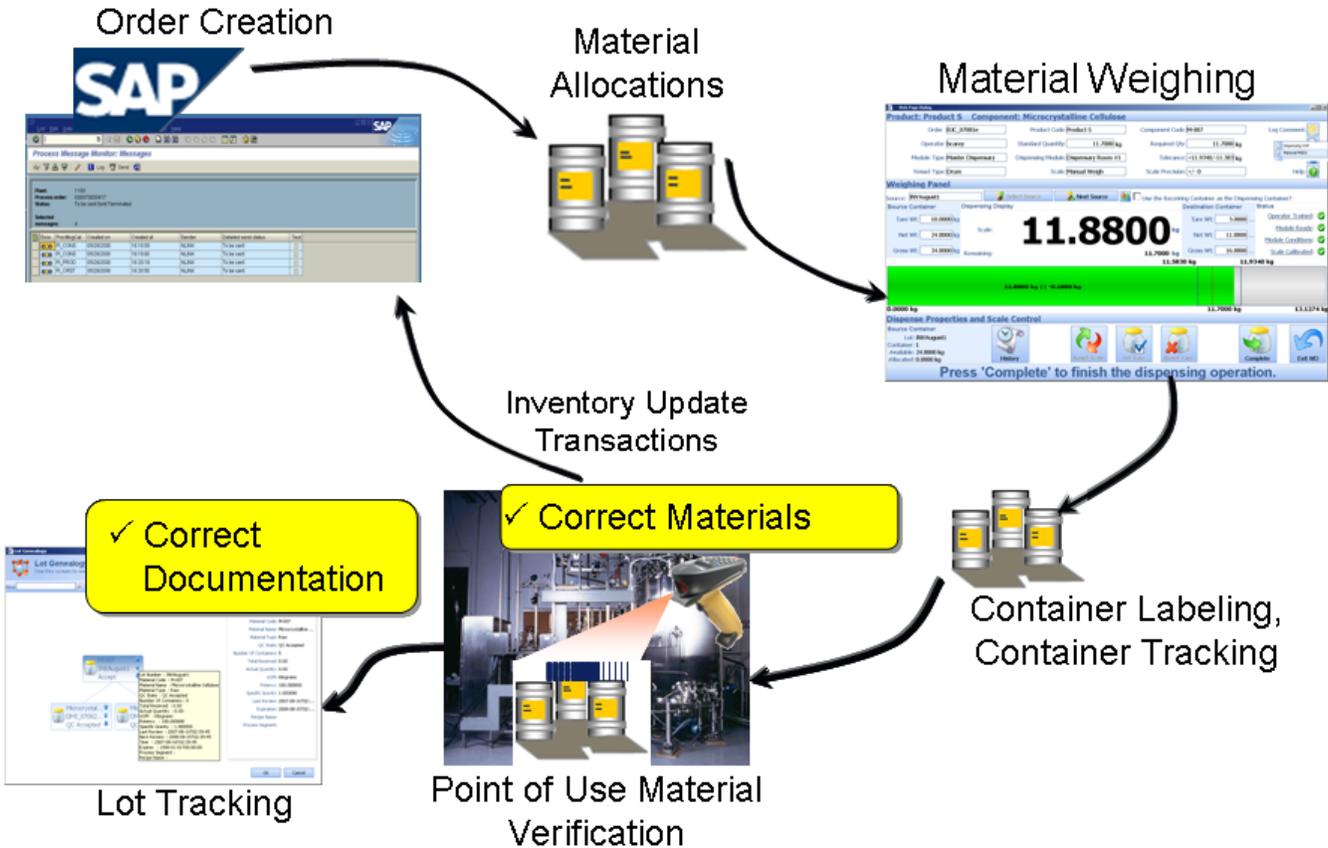


Material Operations

In many process facilities raw materials may be allocated by the ERP, but are tracked by hand written documents on the plant floor and sometime after production is completed consumed materials are transcribed from the hand written production records into the inventory management system to update the inventory to reflect the materials used. This process has several problems. First, there is significant latency between when materials are used and when they are entered into the inventory system, second, manually transcribing material usage from hand written records into the inventory management system can result in data entry errors. These two factors can result in inaccurate inventory, resulting in either excess inventory or inventory shortages. Another problem with this is the lost productivity resulting in having resources having to record material usages by hand, and then later type them into the inventory system.

The integrated process plant provides a better way to track material usage. The ERP creates a production order and allocated material to the order. At this point, the order including the materials are handed off to the plant floor order execution system where materials can be weighed, if needed, then at the point in the process they are charged to the process bar code scanning can be used to verify the correct materials are being used, the plant floor system documents the materials and issues a transaction to the ERP to automatically show the material consumed at the point in time they are used.

Figure 6 Real Time Plant Floor Material Tracking



Conclusion

Process manufacturing facilities that are looking for ways to improve efficiency and productivity, lower costs, and increase capacity utilization should assess the use of automated operations management software system to manage production, quality, and maintenance operations. The use of integrated software systems to perform these capabilities is proven to stream line operations through the coordination of people, materials, equipment, and procedures involved in manufacturing. Elimination of paper based process eliminates errors and speeds production and quality management activities.

Emerson’s PlantWeb architecture has been extended to include Syncade Smart Operations Management Suite providing capabilities for production operations, material operations, and quality operations.

Evaluating investment in software systems for operations management should begin with establishing business objectives and then developing a business case for investment. Emerson consultants can help with overall investment assessments and business case development.

Contact Emerson at Syncade@emerson.com for more information on how Emerson can help you develop a strategy to stream line process manufacturing.

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