



Increasing MES Productivity with Workflow

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1. Introduction

As market demands and business drivers continue to evolve for customers in manufacturing and production industries, it is very clear that organizations are under significant pressure to increase the speed and agility of their business and manufacturing operations.

Agility requires a company to be nimble in how it responds to changing needs in the market. The faster information and decisions propagate through an organization - the faster it can respond to demand and changes in the market. Time-to-market is absolutely critical. Research has shown that agile companies increase their velocity and flexibility by breaking down organizational and information barriers into world-class end-to-end business and manufacturing processes that are focused on delivering high levels of customer satisfaction and product quality.

Over the past decade, many organizations have spent a significant amount of time and effort tuning their Supply Chains and associated core business processes to effectively sense and respond to demand in the market. Today, these organizations have realized that their journey is not complete and there is a need to optimize the manufacturing processes within their plants to drive higher levels of operational excellence in support of corporate business objectives and policies. This need is challenging commercial Manufacturing Execution Systems/Manufacturing Operations Management (MES/MOM) software vendors to extend and enhance the collaboration capabilities of their current offerings to enable customers to configure end-to-end business processes that go beyond the traditional boundaries of MES/MOM deployments.

This paper will discuss how Arcestra Workflow Software from Invensys Operations Management can enhance and extend the collaboration capabilities of MES/MOM by delivering a comprehensive Manufacturing Business Process Management (mBPM) framework that will enable organizations to transform their operations execution landscape into a high performance, harmonized operation that coordinates people, applications (enterprise and production applications) and processes to accomplish specific business objectives.

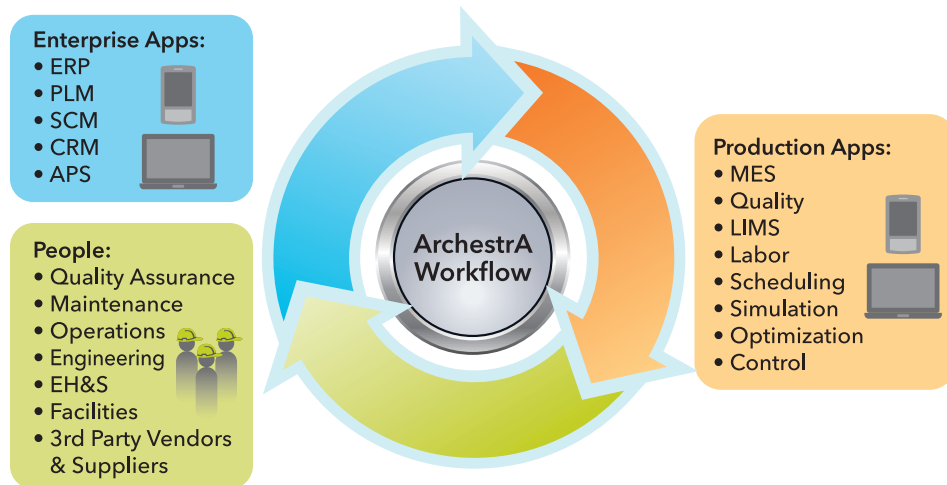


Figure 1: Orchestrating People and Applications into Effective and Sustainable Business Processes

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2. Key Customer Challenges

Most industrial organizations continue to face significant challenges as they attempt to adapt their business processes and policies to improve safety, compliance, quality and productivity, as well as reduce their operating cost. On top of all that, the pace of business just continues to increase year after year and the customer demands become more significant whilst the client-loyalty decreases.

Responding to market dynamics – organizations need to be responsive to market changes and demands, which indicate they need to be more agile and capable of adapting their business processes to respond to new market demands.

Driving higher levels of quality/consistency – organizations continue to struggle to deliver high quality products on a consistent basis. There is a need to drive higher levels of governance without imposing a negative effect on cost or productivity.

Managing compliance & regulation – not only do industrial organizations need to produce high quality product, but they also need to comply with stronger and more complex government and industry regulations and customer specifications.

Coordinating with suppliers & vendors – most organizations employ complex supplier/vendor networks to produce their products. This requires significant coordination to ensure that vendors/suppliers can be tightly synchronized with internal business processes.

Reducing operating costs – faster, better, cheaper. In today's global business environment, the pressure to reduce operating costs is constant.

Managing global operations – most organizations are operating global supply chains that are spread out all over the world. This requires them to manage their plants in a more holistic manner, which includes standardization and governance around business and manufacturing work processes.



Increasing operational excellence – manufacturing and production organizations cannot afford to stand still. Their competitors are working hard to take market share from them. They must increase their operational excellence to compete in the global market place.

These challenges are forcing organizations to evaluate and improve their core business processes within their plants, as well as extend those processes into the supply chain and out to their key suppliers/partners. This paper will discuss how ArchestrA Workflow Software can enhance and extend current and future MES/MOM deployments by providing a comprehensive Manufacturing Business Process Management (mBPM) framework that will help our customer's model, execute, analyze and improve their plant floor business processes to increase productivity.

3. End-to-End Manufacturing Business Processes

When we talk about manufacturing business processes, we are referring to a series of steps or actions that are executed to accomplish a specific business task or objective within an organization. Manufacturing business processes are not limited to production related tasks. All domains in an organization (e.g. Quality Assurance, Maintenance, Operations, Engineering, Environmental Health & Safety, Procurement, and Facilities) have well defined processes for repetitive tasks (e.g. safety inspections), normal operating procedures (e.g. line changeover, QA release, preventative maintenance) and abnormal events (e.g. process alarms, machine breakdown). However, the challenge is many of these processes are embedded in "fit-for-purpose" applications, or manually documented in various formats (e.g. Word, Excel, Web Page, etc.), or executed by subject matter experts (i.e. people-driven processes).

The scope of manufacturing business processes vary in size and complexity depending on the objective. When you analyze end-to-end manufacturing business processes, there are many scenarios where a single process requires a number of applications and/or people to be coordinated to accomplish a specific task. Furthermore, there are many cases where business processes cross-over departmental boundaries as depicted on the next page in Figure 2.

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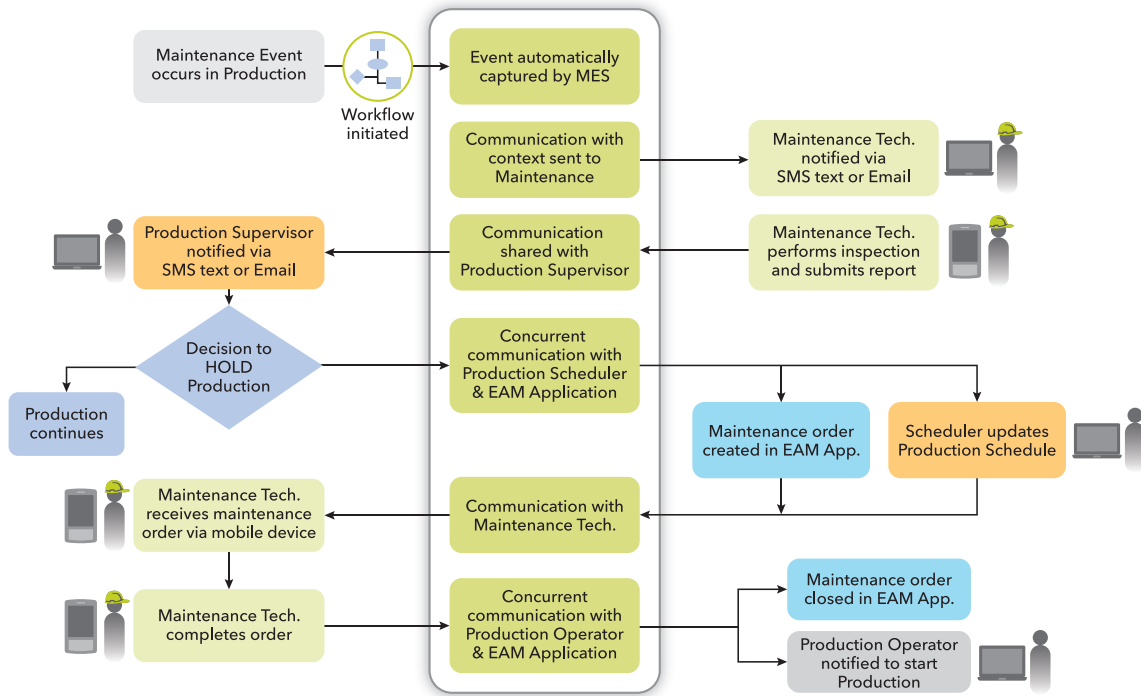


Figure 2: Example of Manufacturing Business Process that Coordinates People and Applications

The following lists some additional examples of manufacturing business processes that cross departmental boundaries:

- Releasing a new recipe/formula to the production floor
- Approving the release of a new product
- Resolving quality dispositions (e.g. lot release and quarantine)
- Creating and executing maintenance work orders (EAM/CMMS)
- Starting-up and shutting-down a process
- Demand/supply management in the plant (e.g. kanban, safety stock/WIP buffers)
- Staging raw materials
- Responding to adverse alarm conditions
- Incoming material inspections
- Non-conformance response or event resolution (CAPA)
- Process order changes
- QA release
- Process order initiation and completion
- Specification change request

The concept of end-to-end manufacturing business process management goes well beyond the capabilities of a traditional MES/MOM application. MES/MOM applications are typically more focused around enforcing and managing production related activities that are attached to a production routing. The overall production routing describes the sequence of value-add operations that transform one or more raw materials into semi-finished or finished goods. Furthermore, more detailed production execution information is attached to each value-add operation to support the production process (illustrated in Figure 3).

- Resources required (e.g. equipment, tooling, materials, labor)
- Operator certifications
- General data collection requirements
- Quality inspection requirements
- Operation specific sequences (e.g. add material, view work instruction, collect data)
- Work instructions
- Specification/recipe data (e.g. process parameters, line/machine setup parameters)
- Production performance requirements
- Routing options (e.g. rework paths, conditional paths)

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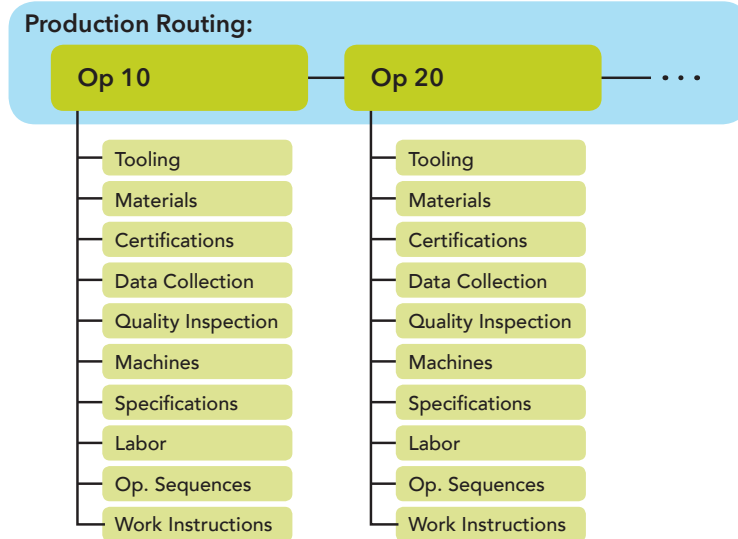


Figure 3: MES/MOM Production Routing

MES/MOM applications ensure that all production sequencing, resource and data collection requirements encapsulated within the production routing are enforced for each semi-finished or finished good that is produced against a particular process order.

However, the reality is that many other tangential processes occur in support of producing a product. These processes are not encapsulated within a production routing, but are equally as important and necessary to support the production process. If we step back and take a look at the end-to-end process required to produce a product, we will see that many stakeholders need to be engaged from different disciplines within the organization (e.g. Operations, IT, Maintenance, Quality, Warehouse, etc.).

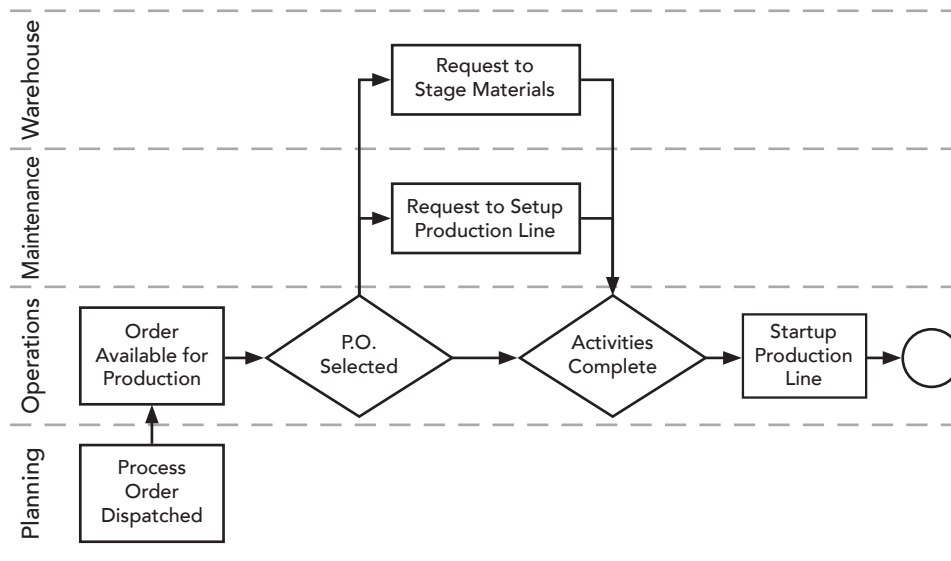


Figure 4: End-to-End Manufacturing Business Process for Process Order Initiation

As illustrated in Figure 4 above, although the MES/MOM application has all of the required information to initiate a process order, the production routing does not establish the process and associated stakeholders for starting-up a production line. There are many other similar process scenarios (e.g. order completion, raw material returns or requests, emergency maintenance request, quality holds and quarantines, etc.) that need to be defined and managed outside of the production rules and procedures set forth within a production routing.

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In the next section, Model-Driven Manufacturing Operations Management, we will discuss how ArchestrA Workflow can extend the core production management capabilities of a MES/MOM application by providing a comprehensive mBPM framework that enables customer to create and manage end-to-end manufacturing business processes in a consistent and compliant manner.

4. Model-Driven Manufacturing Operations Management

Organizations are under significant pressure to increase the speed and agility of their business and manufacturing operations as market demands continue to evolve at a fairly rapid pace. This trend is driving a new paradigm within manufacturing and production organizations called Model-Driven Manufacturing Operations Management (MOM). Model-Driven MOM leverages classic BPM concepts and technology to provide a more unified approach for coordinating manual efforts (people-driven processes), as well as system-automated tasks and information flows (documents, forms, and other semi-structured and unstructured content) – rather than managing them separately and uniquely. Organizations need the ability to effectively manage the interactions across resources (people and applications) to improve operational excellence.

Model-Driven MOM enables process owners (e.g. Operations, Maintenance, QA, IT) to model, execute, analyze and improve manufacturing business processes collaboratively in support of volatile business environments. It provides a continuous improvement framework that enables organizations to innovate processes rapidly, especially those that change often.

Model-Driven MOM is a real breakthrough in the MES/MOM space. As discussed previously, standalone MES/MOM applications do not coordinate or orchestrate all of the manufacturing business processes associated with producing a semi-finished or finished product. However, with Model-Driven MOM, traditional MES/MOM capability is defined as a process within the BPM environment and extended to address the tangential processes that are not encapsulated in production routings. This approach allows customers to visually model and execute all of their manufacturing business processes under a single common framework, enabling frequent and rapid innovation without writing or changing code.

With the release of ArchestrA Workflow Software, Invensys Operations Management is demonstrating its thought leadership around how Model-Driven MOM can be realized in a manufacturing or production organization. ArchestrA Workflow Software is a sophisticated Business Process Management application that enables companies to digitize manual and automated processes that include people, equipment and/or systems.

Let's review some of the key elements of Model-Driven MOM and how ArchestrA Workflow Software enables this next-generation operations execution solution.

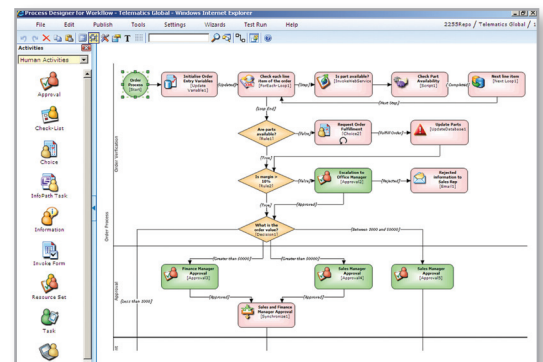
Process Modeling

With Model-Driven MOM, the idea is that all manufacturing business processes and associated user interfaces are abstracted from the underlying applications that are required to support a particular process.

Business processes can be modeled through a large number of methods and techniques. For instance, Business Process Modeling Notation (BPMN) is a business process modeling technique that can be used for drawing business processes in a workflow.

ArchestrA Workflow Software provides an intuitive visual drag-and-drop modeling environment that enables end-users to design all of the manufacturing business processes (e.g. MES/MOM business logic + extended tangential processes) and associated user interfaces/forms that are required to support production and non-production related activities in a manufacturing or production facility.

A manufacturing business process can be as simple as changing the state of a process order at a production work center or as complex as requesting a specification change which needs to propagate through multiple departments and update multiple systems/applications within an organization. The workflow activities that get orchestrated together within a manufacturing business process can be Invensys MES activities and/or 3rd party activities.



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ArchestrA Workflow Software provides the ability to model simple or complex forms that abstract end-users from the underlying applications. These forms can be linked to MES/MOM related activities in the process and can be configured to display and/or collect data.

Process Execution

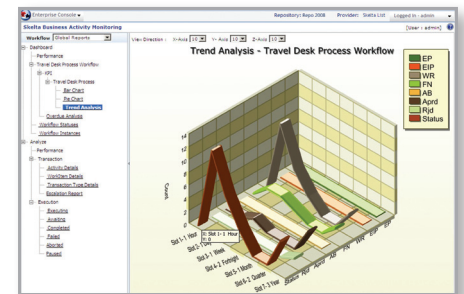
Model-Driven MOM applications are responsible for executing the manufacturing business processes that have been modeled to support production or non-production related activities.

ArchestrA Workflow Software provides sophisticated process execution capability (e.g. human workflow management, task escalation) and is seamlessly embedded into Invensys MES/MOM applications and 3rd party applications to enforce and manage process activities that are assigned to a particular user or area. End-users are able to participate in processes via HMI applications, web browser, smartphones, PDA, email and IM.

Process Analysis

Model-Driven MOM applications provide the ability to analyze the manufacturing business processes that have been executed to determine where improvements can be made to increase the speed and efficiency of the process.

ArchestrA Workflow Software captures a complete audit trail of all activities associated with the execution of a particular MES/MOM manufacturing business process. Standard out-of-the-box performance analysis is provided for each process. End-users can establish proactive alerts of business exceptions and KPIs for MES/MOM related activities.



5. Manufacturing Business Process Scenario

The following scenario describes an end-to-end MES/MOM manufacturing business process that can easily be managed by ArchestrA Workflow Software.

Scenario Background:

Bill is required to inspect all raw materials that are being staged for consumption at the packaging line to ensure that all materials are compliant with the specification established by Company ABC. If a raw material does not meet the packaging specification, Bill is required to place the material on hold and escalate this issue to Jay for resolution. If Jay chooses to send the material back the vendor, it may be necessary to involve the purchasing department.

Business Objective:

Provide a solution that is capable of managing the material inspection and quality hold resolution process in a consistent, compliant and timely manner.

Workflow Systems and Participants:

- Wonderware MES
- Wonderware InTouch
- ArchestrA Workflow Software
- Jay – Production Supervisor
- Sue – Purchasing Agent
- Bill – Packaging Line Operator

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End-to-End Scenario:

- 1.) Bill has started a particular production run at the packaging line using the Wonderware MES work queue control within InTouch. Bill needs to stage some bottles in the filler and activates the "Material Inspection" form within InTouch. The "Material Inspection" form invokes an instance of the "Material Inspection" workflow within ArchestrA Workflow Software.
- 2.) The "Material Inspection" form displays all of the visual characteristics that need to be inspected prior to staging the bottles at the production line. The form retrieves the visual inspection characteristics from the Wonderware MES database. Bill is required to enter PASS/FAIL for each of the visual inspection characteristics.
- 3.) Bill notices that the color of the bottles is not correct, and enters FAIL along with a detailed comment and closes the form.
- 4.) Upon closing the "Material Inspection" form, the workflow will:
 - Invoke a MES transaction to change the state of the raw material lot to "QUALITY HOLD REVIEW"
 - Send a task via email to Jay to resolve the quality hold
- 5.) Jay accesses this email message via Outlook on his desktop PC. Jay accesses a form, via a link in the email message, which displays all of the visual inspection data Bill entered, as well as the comments.
- 6.) Jay has two options: resolve the quality hold or return the material to the vendor.
- 7.) If Jay chooses to return the material to the vendor, then the workflow will:
 - Send an email to Sue with all of the supporting information required to initiate a RMA (Returned Material Authorization) process with the vendor
 - Invoke a MES transaction to change the state of the raw material lot to "RETURNED TO VENDOR"
 - Terminate the workflow
- 8.) If Jay chooses to resolve the quality hold, then the workflow will:
 - Invoke a MES transaction to change the state of the raw material lot to "APPROVED"
 - Terminate the workflow

To meet the business objective, the material inspection and quality hold resolution process is graphically modeled in ArchestrA Workflow Software. Workflow tasks are delivered to the participants via preferred communication channels (e.g. HMI, email, etc.). The workflow ensures that all required resources (people and applications) are coordinated in a consistent and compliant manner, as defined by Company ABC stakeholders. Additionally, escalation rules are configured for various activities within the workflow to ensure that the process is completed in a timely fashion.

6. Summary

To remain competitive and profitable, manufacturing and production organizations must take action to break down organizational and information barriers into world-class end-to-end business and manufacturing processes that are agile and sustainable.

Invensys is positioned to help our customers overcome this barrier to operational excellence by providing the foundation for people and process performance with ArchestrA Workflow Software. ArchestrA Workflow takes existing MES/MOM applications and brings them new means for collaboration, standardization, and enforcement of best practices and operating procedures. ArchestrA Workflow brings true productivity improvements to an organization.



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