

Digitize Work Processes with Industrial Workflow Execution

Optimizing Your Production with SOA-Based Industrial BPM

Industrial workflow digitizes and streamlines your production – from your work instructions and SOPs to corrective action and HACCP monitoring. You can integrate your business and production processes across systems and departments for reliable, repeatable process execution.



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Introduction

Every production environment contains a mix of automated and manual interactions between equipment and personnel. Often, these production processes are not fully documented and include extra steps and resources. As such, they are difficult to adapt to changing business needs. Additionally, as workforces age and retire, organizations are losing the knowledge that is gained from years of experience on the plant floor – as the information has not been captured electronically and put into formal processes.

Digitizing work processes offers a way to evolve production – leveraging the methods and technologies that Business Process Management (BPM) brought to the enterprise. By documenting, leaning and digitizing production work processes or workflows, companies can achieve greater agility and long-term sustainability.

Driving Toward Digitization

MES and Production Management solutions have been evolving over many years as very broad or very specific solutions to manage production operations. In most cases, companies had to significantly customize production systems which meant they could not be easily upgraded or improved and often remained static. Changes to the systems have required large commitments from Manufacturing IT resources, leading even farther into customization and making the systems even more difficult to maintain.

While MES has been solving scheduling, execution, and data collection challenges for years, it still remains mostly a static solution when it comes to the processes these systems execute. Due to the limitations of these systems, companies have hundreds of workflows or processes within every production facility that are executed manually.

Today, a manufacturing composition environment is evolving that supports process orchestration, workflow and alerting. MES solutions are moving into the realm of operations process management, and Enterprise Manufacturing Intelligence (EMI) solutions can now include workflow capabilities in their dashboards, making systems more actionable and capable of simple execution.

With these advancements in technology – and the availability of low cost computing resources – the ability to digitize work processes has become a reality. An industrial workflow software solution can sit on top of existing plant systems and fill the gaps in most MES, production and control systems. Industrial workflow software allows domain experts, not just programmers, to create workflows that orchestrate services and communicate to real-time equipment. Industrial

workflow, when based on an industrial Service Oriented Architecture (SOA), can also make existing systems more flexible and adaptable to change – which brings the power of digitization to production teams.

The Power of Digitization

- *Lean your processes – improve, eliminate and automate steps*
 - *Manage by Exception*
 - *Automate information flow from Plant2Enterprise and Enterprise2Enterprise*
 - *Integrate people and their roles/functions*
 - *Customize to individuals' work styles and decision making*
 - *Manage and audit your production processes more effectively and consistently*
 - *Share production best practices and collaborate on processes*
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Grow with the Flow

By definition, a workflow is the automation of a process during which information or tasks move from one participant to another for action, according to a set of rules. As an enabling tool, industrial workflow software provides a system for improving and optimizing industrial and manufacturing practices – combining automated and manual processes through authoring, execution and analysis capabilities. This software takes a production “flowchart” and digitizes it, connecting people, equipment and systems. Unlike BPM in the enterprise – which operates in hours and days – industrial workflow operates in a time window of seconds and subseconds.

Just as production has a broad range of work processes, industrial workflow software can solve a broad spectrum of challenges. Workflows can involve basic tasks such as asking an operator to check tank levels every hour, to managing an entire production process, to orchestrating data transformations between ERP and MES. The workflow system – and its reporting – can touch almost all production personnel, including quality managers and quality technicians, maintenance, operations supervisors, industrial engineers and more.

Additionally, digitization of a process can involve one or many steps. It can take place in one station with one user or spread across the plant and move from person to person, following a set of rules. The workflows follow the execution path logic developed by the power user through easy-to-use graphical authoring tools.

Authoring a Workflow

Industrial workflow typically does not require IT resources, and power users are able to make changes to the system to immediately improve production. The graphical authoring environment permits drag-and-drop construction of workflow diagrams or the execution process.

Following definition, the workflow moves to the execution engine. A typical plant could have 60-100 workflows executing at the same time, depending on the industry. In the case of an interactive workflow, the workflow then gets pushed to the next functional area, which is the task client. The task client shows a backlog of tasks for a role and location. In the case of a system workflow, the workflow does not have interaction with end users and runs behind the scenes. For example, a company could have several system workflows that are communicating with the ERP regarding material consumption or other information.

The steps for authoring a workflow include:

1. Document your new or existing process.
2. Identify, eliminate or reduce non-value-added activities.

Lean out the process. By using industrial workflow, companies can look at their processes, often for the first time at this level, evaluate them, and make significant improvements.

3. Describe the event, or combination of events, that will trigger the workflow to execute.

Triggers can range from particular data coming from a PLC to a production event in an MES system to information from an HMI node. Users can combine several with one conditional statement to trigger a workflow. Or, users could trigger a workflow with time-based events.

4. Define the conditional process logic that will dictate the appropriate types of actions.

Power users dictate the execution path – which specifies the specific tasks to be completed within the workflow.

5. Identify recipients – and what data they require to make the correct decisions and complete their tasks.

For every step within a workflow, users can attach documents and work instructions to assist and speed with execution.

Each step could include linked documents such as work instructions – or any information that pertains to how the user should complete the process.

Unlike traditional systems, industrial workflow allows production teams to mix automated and manual tasks. Figure 1 shows a simple workflow to process a production order, as follows:



Figure 1. Mix Automated and Manual Tasks
Unlike traditional systems, industrial workflow allows production teams to mix automated and manual tasks

1. Set up machine and download recipe.

The ERP triggers an event that a work order is passing down to the MES system, and a workflow begins and pushes out steps to different places or stations within the plant for execution. In this example, Task 1 is pushed out to a particular production machine and provides set up instructions to the operator in the form of attached documents.

Once the machine is successfully set up, the workflow system could communicate to a SCADA or HMI system – or it could download the recipe directly. The workflow system has access to real-time data sources such as PLCs, OPC servers, custom process equipment, and more. With

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completion of these first two steps, the operator finished set up, downloaded the recipe, and put the machine into production.

2. Visually inspect product.

As the product moves down the production line or from cell to cell, the operator receives a task to do visual inspection for that particular production order. The system provides work instruction for how to perform the visual inspection. Within that task step, the system requires Manual Data Entry, as the operator inspects the product. The operator enters the information into an easy-to-use form, which is set up specifically for that task. The system pushes the inspection data into other systems – such as MES, LIMS and HMI.

3. Package product.

With the visual inspection completed, the product moves to packaging. At that station, the packaging operator receives instructions on how to package the product and moves through a workflow that even includes printing the package labels.

4. Pallet and ship.

Once packaging is completed, the product moves to pallet and ship. The operator receives more instructions on what packages to use as well as materials and other information. The workflow system automatically pushes information back up into the ERP, so the ERP now contains the completed order information – including which pallets, which exact products and other details.

Industrial Workflow Across Production

Use cases for industrial workflow vary from company to company and industry to industry. However, many organizations face common production challenges. Common use cases for industrial workflow include:

Orchestrate high-level processes and manage the data between systems – Many companies do not have visibility into their high-level processes and do not have them documented – and even fewer are orchestrating systems and managing the data between them. The example in Figure 2 shows the high-level workflow for a brewery that needed to achieve process visibility and management. Located in Europe, this leading brewer had no way at a high level to prepare a batch for execution. In the illustration, the high-level workflow consists of the blue boxes. The first step, “define the brewery setup,” goes to an engineer – whose actions trigger another workflow, or a nested workflow, as shown with the flowchart to the right. The engineer executes that workflow and defines the setup. Once completed, the workflow moves to the next engineer, who then looks at the site recipe, checks if it requires changes, makes any modifications to the master recipe, and creates the batch. Next, the production team examines the control recipe and, finally, starts processing the batch. This new digitization gives the brewer visibility across the business into all of the batches that production is processing. From one place, the brewer can look at all of the batches that are currently under dispatching and scheduling and see where they are at without personnel having to leave their desk. People, systems and processes are all interconnected.

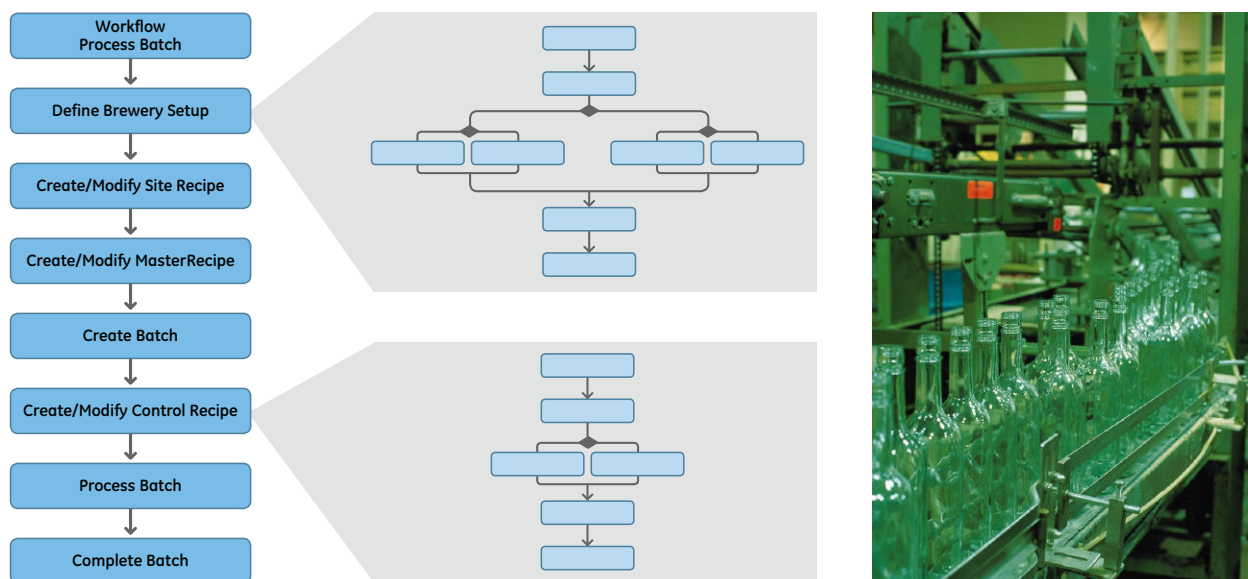


Figure 2. Orchestrate Entire Production Processes

A major brewer used industrial workflow to achieve process visibility and management. This new digitization gives the brewer visibility across the business into all of the batches that production is processing. People, systems and processes are all interconnected.

Digitize Good Manufacturing Practices (GMP) Tasks – Because GMP tasks can become part of the digitized workflow, companies can push the tasks out to personnel and equipment. The system sends instructions to operators at their stations and requires them to complete the tasks. The system records the details regarding task completion. For example, if a machine is constantly in production, the system may require the operator to check it, as the individual process requires. With a packaging machine that is applying labels, the operator may need to check adhesive levels every hour and confirm completion of the task.

Digitize Standard Operating Procedures and Work Instructions – Instead of using a static piece of paper or a binder at their station, operators follow SOPs and work instructions through industrial workflow. They accomplish their work with fewer errors – and the system records the information.

HACCP Monitoring Procedures and Corrective Action – Now, production teams can use industrial workflow to create HACCP procedures – and build the corrective actions that are necessary if there is a negative response to one of those procedures. As companies execute on a HACCP check, teams need to collect the data on corrective actions – when they are taken, how, and what the response to the corrective action was. Industrial workflow provides a full closed loop for HACCP.

Alarm and Event Response, Corrective Action – While industrial workflow monitors alarms, companies can also layer it on top of HMI – and monitor alarms through the SOA platform. Workflow can filter out nuisance alarms, so teams only need

to take action on certain alarms. Additionally, industrial workflow can eliminate the scripting, traditionally VBA coding, in many HMI applications. As shown in Figure 3, industrial workflow provides a better way – one that is 30-50% faster than HMI scripting and easier to maintain.

Manual Assembly Error-Proofing – Industrial workflow provides station level control for assembly and error proofing – while also fully documenting products, people and resources for traceability.

Plant Task Management, Decision Wizard – In addition to extensive plant task management, industrial workflow also offers a basis for decision wizards. At a major consumer products company, teams have now documented troubleshooting trees for the first time. These trees capture the knowledge of workers due to retire before employee attrition affects the plant. Industrial workflow digitizes the trees into decision wizards that walk newer employees through processes. The digitized decision trees help guide the newer workers on what corrective actions to take under certain circumstances. The system may ask the operator for input – or may require input from many people. Industrial workflow helps to manage the process, connecting knowledge, teams and equipment.

Line, Workcell, Machine Setup – To speed production and increase accuracy, industrial workflow facilitates machine setup. The system walks users through the setup of a machine, provides machine documentation and records the time it takes for operators to move through each step.

In reviewing the use cases, industrial workflow spans production challenges from machine setup to managing entire production processes and communicating between many different systems. As the complexity of the workflows increase, industry standards become more and more important to ensure successful execution.

Enabling Industrial Workflow with Industry Standards

To create common ground between systems, companies need a common definition of data. Even at the simple end of the spectrum – such as a workflow that performs basic tasks – companies must exchange and store data.

The S95 standards provide a common framework and data model in which different systems can communicate and give context to data found in static and real-time systems. Once standard data models are in place, workflows can use the data within the models to carry out their execution and have a place to store results of execution.

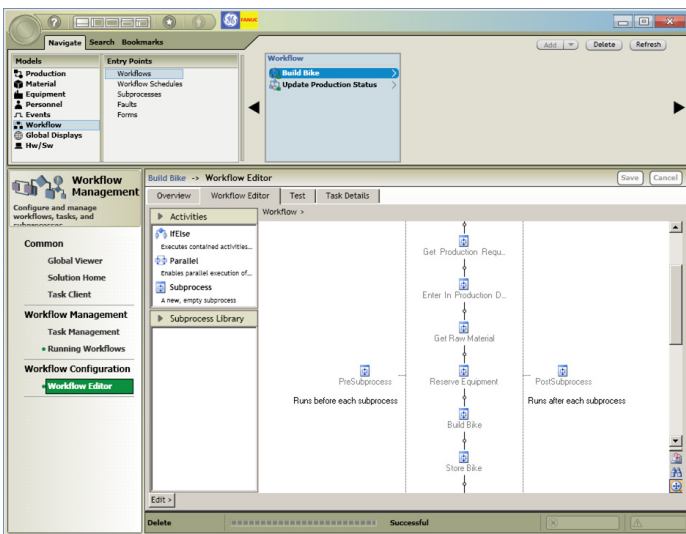


Figure 3 – Workflow Authoring Environment

In a graphical environment, power users can drag activities into the canvas area to create a workflow that visually resembles a flowchart. The system allows users to set properties, add a form and set conditions, create templates, select from libraries of workflows and subprocesses, and publish into repositories for reuse across the business.

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In addition to ensuring commonality with S95 standards, industrial workflow from GE Fanuc leverages the Windows Workflow Foundation to ease implementation and use. Microsoft deploys the Windows Workflow Foundation with the Windows Operating System – making it familiar, readily-available functionality. By building on this proven Microsoft technology – and adding transformational innovation on top of it – an industrial workflow execution system allows companies to get up to speed quickly and with minimal deployment effort.

Furthermore, Windows Workflow Foundation is an integrated workflow engine embedded in many familiar products – such as Microsoft Office 2007, Microsoft BizTalk Server 2006, SharePoint, .Net, and other applications – already commonly used in organizations. This means that teams already have expertise with enterprise-level workflow technology as well

as access to libraries of applications. With a common workflow engine, companies can repurpose workflows and make them repeatable, so they can be leveraged throughout the organization. Cross-functional teams can share workflows and create templates to encourage reuse – saving time and eliminating any redundant workflow creation.

Workflows are a key element to connecting and managing flexible work processes that can be very dynamic. By leveraging a common reference model and workflow engine layered on with transformational innovation specifically to improve production operations, companies can enable workflows to execute across many systems – and know that they have achieved a foundation for sustainable advantage.

For more information on industrial workflow, visit:
www.gefanuc.com/workflow

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