Best Practices for Global MES Rollouts

Multisite, global manufacturing execution system implementations can be optimized by applying Agile methods to development and program governance.

Executive Summary
There is now agreement that effective rollout of a global manufacturing execution system (MES) is critical to achieving manufacturing excellence across the enterprise and rapidly scaling up production to meet customer demands for new products. Nevertheless, manufacturers still struggle to replicate MES benefits across all of their production facilities. As a result, standardization of processes and activities across sites has become one of the top priorities for global manufacturers.

In addition to standardization, many manufacturers lack a solution development methodology that can bring additional agility for meeting dynamic market requirements and the realization of increased value in shorter time spans. Abstracted from our experience deploying global systems, this white paper presents the best practices in a practical, global program management framework for MES deployments, with special focus on Agile solution development adoption in MES implementation. This white paper also offers examples of typical global implementation challenges and ways manufacturers can effectively mitigate them.

Global MES System: A Business Perspective
Global players generally tend to have multiple sites manufacturing multiple products. The objective is always to churn out maximum ROI from installed assets across sites.

Global visibility, in addition to site-specific visibility, becomes important to consistently devise continuous improvement strategies to achieve maximum ROI. The magnitude of complexity as organizations move from single site to multiple production sites is typically enormous. Establishing a suitable integration strategy for all sites is therefore key for manufacturers seeking to enhance visibility and take steps necessary for improving operational efficiency and reducing production cycle times.

An Operations Perspective
To retain market leadership and to ensure better-quality responses to customer demands, leading manufacturing organizations are normally laser focused on achieving global excellence. According to our observations, most companies report that they already have a global strategy in place to unify processes and systems across locations. However, they typically fall short of achieving this vision.

Although they acknowledge an absolute need for a global MES system, numerous challenges must be overcome for smooth deployment of the right solution. Moreover, they face obstacles meeting diverse needs across functions and locations that span multiple stakeholders. Business process improvement through standardization is a major driver for transitioning from a local to a global MES strategy.
First, it is essential to manage the common requirements and identify the best practices. Second is the challenge of conceptualizing a global solution within architectural boundaries and complexities, with a perfect balance between cost, functionality and schedule, and making it work. Finally, there is a need to look closely at these inputs to manage the change and acceptance of the deployed global system in order to achieve operational excellence.

Other challenges include:
- Lack of an effective program/project governance model.
- Barriers in cascading best practices across sites.
- Cultural and mindset challenges around training and change management.
- Conflicting and changing requirements across sites.
- Legacy systems working in isolation.
- High operational interdependencies among sites.
- Availability of the right subject matter experts at the right time during solution development.

Overcoming these challenges can yield the following benefits:
- Integrated sites with a smooth flow of information.
- Continuous improvement through replication of best practices across sites.
- Standard reusable templates.
- Multisite visibility for important parameters.
- Better control of load balancing across sites based on demand.
- Seamless information exchange with legacy systems.
- Statistics from multiple sites enabling corrective action and preventive action (CAPA).
- Lower system maintenance costs.
- Improved KPIs focused on operational excellence.
- Reduced production cycle time and reduced waste.

An Agile Governance Model
The first step in any successful MES implementation is determining clear governance for the project. Deliberate thought should be given to how manufacturing processes will be governed throughout the entire MES implementation in tandem with the site ecosystem, from a program management and execution perspective. Governance topics should address who has authority to change a process, and how will that process change be tested, implemented and measured across the entire application infrastructure. The answers to these questions will ultimately determine operational agility.

Having a clear governance plan in hand requires the input and involvement of all stakeholders, even if some of them will not be directly involved in the implementation process (see Figure 1). To establish a proper governance process, organizations need to look beyond IT and production and into quality, validation, operations, maintenance and executive management. Governance is where the project should start, and it’s where it will break down if not properly instituted.

An Agile Methodology
As with any conventional implementation project, opinions on which specific steps to follow vary widely. In general, most organizations when deploying MES tend to follow a classic project planning methodology involving design, configuration, testing, deployment and the post-go-live maintenance lifecycle. To smoothen the implementation process, some companies have begun to apply Agile development methodologies to the process of architecting the implementation plan. By using an iterative and incremental approach with smaller “chunks” of functionality delivered and managed by the governance team, miscommunications and the inability to identify necessary scope criteria can be quickly and effectively minimized (see Figure 2). Operational readiness, therefore, becomes very important for the adoption of Agile methodology and should be part of the initial project review.

As listed below, a dramatic shift is under way in manufacturers’ expectations in MES capabilities.
- Deliver accelerated results, with reduced total cost of ownership.
- Holistic, quality implementation focused on quick time-to-value.
- Early and frequent confirmation of the delivery of benefits.
- Demonstrate capability to solve customer pain points early in the deployment.

Many manufacturers have adopted a combination of Agile methodologies and lean practices...
in recent times. This provides them with the agility required to respond to changes that result from lean methodology best practices. Typically, solution building is achieved by using Agile techniques across the design/build/test phases, where small chunks of the solution are developed, tested and demonstrated to relevant stakeholders before moving to the next Sprint. Once the solution is developed and is complete in all respects, system test and validation is performed in non-Agile fashion before MES goes live at a particular site.

If manufacturers plan to use a COTS product rather than building the solution from scratch, then the Agile methodology depicted in Figure 4 (on page 4) should be adopted.

To effectively leverage Agile in a global MES
rollout, the following best practices should be considered:

- Iterative delivery of business value through capability demonstrations.
- Early and incremental visualization of the solution.
- Time-boxed and inspected delivery of incremental MES capabilities.
- Simplicity and elimination of “waste.”
- Improved visibility and better control of project progress.
- Development iterations conducted in short time frames that are time-boxed.
- Working solution as a measure of progress.

**MES Global Implementation: Agile Methodology (COTS)**

![Sample Agile Implementation Project Plan](image-url)

![MES Global Implementation: Agile Methodology (COTS)](image-url)
• Value prototyping.
• Flexibility, as in the ability to respond to change built into the methodology where change is not a surprise but rather is anticipated.
• Close engagement of business users in the entire process of defining, designing, building and validating the solution.

Best Practices: An In-Depth Look
A global approach to MES necessitates the formation of a “core solution group” at the start of the program with inputs from various production sites. This group is endowed with the responsibility and accountability for designing and building the solution that can be used at multiple sites. This core group drives the standardization across sites by using consistent templates. The core group is responsible for capturing the majority of the functionalities, key performance matrices, reports, etc. that are required at each plant in a single standard reusable form. This will ensure standardization of processes/practices across business units and amalgamation of the operation strategy.

In a validated environment, such as pharmaceuticals or food and beverage manufacturing, this approach helps in terms of effort reduction by using validated core solutions. The core group also helps to cascade the best practices captured from various sites, which in turn helps in achieving global manufacturing excellence.

The most important aspect of this approach is the advantage that it provides in terms of decreasing implementation expenses, reducing the total cost of ownership and minimizing deployment risks. Development and deployment cost is minimized by reusing the global core solution after the first site is implemented. The implementation risk is minimized by maintaining high usage of global templates and standard operating procedures as well as the involvement of the core team for local implementation and support for the rolled-out sites. The following are strategies to consider adopting to ensure successful global MES deployment:

• The scope must be informed by two or three key business drivers. All requirements and functionalities should trace back to these business drivers.
• One common global template should be used to foster consistency, and to make future changes easier.

• Standards in developing a baseline solution must be enforced. Organizations therefore must leverage core product functionality.
• A program management framework should be implemented with projects coordinated by the central core team, with adequate participation from sites.
• Organizations need to provide “hooks” or plug-ins to address site-specific requirements.
• The core team must create a robust release management and version control process for baseline enhancement and deployment.

MES deployment should be treated as an individual project for each site deployment. This needs to be implemented through a robust program management framework. Every global MES deployment project starts with a baseline solution that becomes a stepping stone for global deployment. It is very important to develop a standard yet flexible baseline solution in order to ensure success of the global MES deployment.

Organizations should invest time during the initial phase of the program to ensure the core solution meets the business requirements of the first plant before rolling it out to the rest. Ideally, the choice of this first plant should be representative of all the complexities that can be envisioned in the entire set of plants across the global business. This core solution is then applied to the next plant in succession.

In the requirement analysis phase, only the gaps between the core solution and the plant processes should be captured for given plant-specific development and deployment. Each plant should count on reusing the functionalities from the core solution wherever possible and customizing capabilities for any site-specific requirements. Best practices

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and customizations at each plant that are identified during solution deployment are then incorporated and fed back to the core solution to be used by future plants. However, provisions of time and money associated with this exercise need to be thoroughly considered.

Project deployment is coordinated by the central core team, along with the local deployment specialists. The core team is responsible for harnessing the knowledge base, maintaining a global solution approach and change control. Figure 5 depicts a typical team organization and execution track for global deployment.

MES installations are challenging, and a flawed implementation strategy will prevent the system from achieving its full potential return on investment. It is especially important to look carefully at underlying work processes to determine where inefficiencies reside, or the organization will merely transfer these inefficiencies from a paper to an electronic medium.

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that people working at the facility understand the manufacturing process, as well as the issues that currently impede efficiency or compliance.

Once problems have been identified, teams can match them with available MES functionalities. Most MES systems are modular, with each module focused on a given function such as finite scheduling, dispensing, electronic batch records (EBR), equipment management, performance monitoring or recipe management. Modules include interfaces to ERP, document management, laboratory information and plant-floor automation systems.

Moving from Paper to Digital

When moving from a paper-based manufacturing system to an electronic one, it is critical not to blindly map from one medium to the other. There may be inherent inefficiencies in the process that will result, whether your organization uses a paper or an electronic system. Thus, an MES implementation offers an opportunity for process improvement and optimization by converting all paper-based records to electronic records, reducing human error, increasing data accuracy and reducing the cycle time for batch manufacturing.

If the MES implementation is part of a global corporate rollout, many of the functional requirements will be identical for numerous plants. In such cases, adopting one core solution will result in benefits of scale. This is particularly true for validation documentation. The core functionality can be documented and validated for all sites by a corporate team, so individual sites are only responsible for their own local configurations.
Taking this approach can drastically reduce the time, cost and resources required for validation. Not only will the benefits be related to the MES functionality of the particular package used, but it is also highly likely that the interfaces to other systems (e.g., ERP) will be the same across sites. Furthermore, if any customizations are required, they can be bundled into a core package, enabling greater control to be maintained and allowing more leverage for the user organization to obtain vendor support for these through system upgrades.

**Phased vs. Big Bang Approach**

If multiple MES modules are being implemented, the question arises as to whether to adopt a gradual, phased approach versus a “big bang” implementation. A phased approach allows the organization to use fewer project resources over a longer period of time. This can be an important consideration if experienced, cross-functional resources are hard to come by.

Furthermore, a phased approach may reduce the time-to-benefit for key modules. Other aspects of phased approaches may be to deploy the MES solution on one line, or train, and then, once it is running successfully, to roll it out to the remainder of the plant. This approach has the benefit of reducing risk to the entire manufacturing facility, should any unforeseen problems arise.

On the other hand, a big bang approach can provide all the benefits in a single “go live.” While this approach will take more time and resources before any MES benefits are realized, it may be suitable for a new green-field site, where impacts to the current manufacturing processes would not exist.

**Additional Considerations**

**Training and Change Management**

User training and change management are critical aspects of a successful MES implementation that are often overlooked. Not only must users be trained in the technical aspects of the system, they must also be made fully aware of the implications of their actions.

Although training may seem a trivial task, scheduling it so that all operators are fully trained before the MES system goes live in a working plant requires careful planning. And it is every bit as vital to a successful MES rollout as the technical aspects of the particular system being installed.

**The Mandate: Keep ERP and MES Integration Simple**

Due diligence is necessary when it comes to choosing application integration interfaces. An interface that provides value on either side should be part of the integration strategy. There could be numerous data that can be exchanged but could be of little value and relevance, thus overloading the network. MES software typically manages production orders on the shop floor, collecting information on what materials are used, process parameters and errors. It compiles a detailed record of how something was built – and how well. An ERP system models a product and the materials that go into it from an accounting point of view.

When setting up a data flow between these two systems, companies need to determine a division of labor to ensure that each does what it does best, and that no conflict results from both attempting to perform the same functions. Companies should limit information exchange to what’s needed for collaboration when linking ERP and MES systems. The message is clear: “Keep it simple!”

To reduce both short- and long-term risk, interfaces should be kept as simple as possible, and the amount of data transferred between them should be kept to a minimum. When using interfaces, even standard ones, follow the methodology laid down by industry standards. The ISA-95 Standard Enterprise — Control System Integration provides a framework within which a system in an integrated solution should perform certain functionalities, together with the key data exchange that should occur between interfaces.

**Accelerators: Replication Tools Development**

In large multisite implementations, it is usually important to maintain the sanctity and integrity of existing large volumes of data. This requires replicating the data from the old system to the new one. This could be a major task if done manually.

In situations like this, organizations should always look for an opportunity to develop a replication tool to automate migration of data to the new system. This will help to dramatically reduce deployment time, which in turn will result in a huge amount of cost savings. These tools can also
be maintained and kept up to date with future releases of core solutions.

**Learning Logs and Knowledge-Based Articles**
Knowledge-based articles (KBAs) are very handy tools to increase the collaboration among various site teams. All the issues, technical or functional, that are resolved at the site by the team can be submitted as a knowledge article and stored in a central repository. Other site teams can leverage them at their sites to deal with issues of a similar nature.

**About the Author**

Alok Shrivastava is an Associate Director within Cognizant’s Engineering and Manufacturing Solutions (EMS) Practice. He has 18-plus years of professional experience, with a focus on MES, EMI and industrial automation solutions. Alok has designed and deployed global control systems and MES solutions for large manufacturing companies across geographies, primarily in pharma, power, chemicals, food and beverage, petrochemical and refineries. He has also led MES and EMI product development groups and was responsible for the development of batch, track, MES, OEE and manufacturing intelligence products for one of the major industrial automation companies. He can be reached at Alok.Shrivastava2@cognizant.com.