Manufacturing Execution Systems

Standardizing the Global Plant Network for High Performance

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Most industrial companies with regional or global operations have worked hard to standardize their enterprise resource planning (ERP) landscapes. Standardization has helped them reduce information technology (IT) costs and enabled further improvement initiatives, such as the implementation of shared-services groups. A key to this standardization has been the use of shared, harmonized ERP templates in rolling systems out across different sites.

On the shop-floor however, most companies still support their production operations with disparate solutions. In industries such as mining, chemicals and metals, this pattern is often repeated from one facility to the next. Thus, manufacturing IT landscapes can be quite complex, and have a wide variety of solutions supporting the same types of processes in different plants.

As a result, a number of multinational companies are working to bring greater standardization to the management of shop-floor systems across their networks of plants. Having seen the value of implementing standard, centralized enterprise resource planning (ERP) systems, they now see the potential of taking a similar approach to manufacturing execution systems (MES).

As with ERP systems, the key to effective MES standardization across plants is a multi-site, multi-country template that spells out a consistent approach to MES that can be used across plants. The use of an effective MES template can help companies gain a more comprehensive view of all plants in the supply chain, achieve better control over plants, and optimize the plant network as a whole to drive operational excellence in manufacturing.

However, creating and implementing such a template can involve challenges that extend far beyond technical issues. An MES template will usually have to encompass a variety of plants that may be making different products. Companies will need to have a shared design and template-definition process that builds alignment and agreement across plants—perhaps hundreds of them—and find ways to layer standard approaches onto disparate operations and different cultures.

These challenges are real, but they can be overcome. Accenture’s experience has shown that by understanding the issues involved, and planning carefully, companies can create and use effective multi-site, multi-country MES templates. And those factors can be the key to driving the kind of standardization across plant networks that can help companies achieve high performance.
The value of the MES template

In operating their plants, most large industrial companies use a variety of shop-floor systems from different suppliers, as well as custom systems developed in-house—tools that in many cases are quite old.

Many of these applications lack key functionalities or are too rigid to allow companies to effectively implement them across more than one plant. In addition, decisions about purchasing, implementing and maintaining these systems are made at the local plant level. As a result, the costs of these systems are often hidden in the local maintenance budget, and each plant typically depends on its engineers and systems suppliers to keep the technology up and running. In some cases, mature MES technology has been implemented, but only at the local level, and these systems are typically customized to fit the plant's equipment and practices.

This approach may work well enough for the individual plant, but not so well for the company as a whole. With plants essentially operating separately, it is difficult to share knowledge, benchmark operations effectively or make network-wide changes to improve performance and cut costs. There is no common vision for the information technology (IT) that supports manufacturing. This situation can complicate matters when it comes time to adapt to a changed regulation or a new strategy, or integrate acquired plants into the company’s ERP system.

An enterprise-wide MES template, on the other hand, provides a foundation for standardizing processes and systems. That in turn helps the company increase visibility into individual sites and make decisions that optimize manufacturing across the plant network. This increased visibility can help companies improve throughput, yield, efficiency, inventory cost, energy consumption, and so on, while keeping manufacturing IT and operating costs down. An enterprise-wide template also enables the sharing of leading practices and critical skills; provides the increased agility needed to keep pace with business, technology and regulatory change; and enables companies to ramp up new greenfield plants with greater speed and reliability. And it reduces the number of disparate technologies in use, thereby simplifying efforts to integrate shop-floor and ERP systems and reducing the need to maintain a wide range of technology skills in-house.

Figure 1. Differences between MES implementations can be avoided to a large extent by using packaged software and off-the-shelf accelerators for specific industries.
Finding the appropriate balance

The potential value of an enterprise-wide MES template is clear enough, but turning the concept into reality can be a struggle.

One of the key obstacles to implementing the MES template is the belief that plants are fundamentally different from one another, and that each one is essentially unique—and therefore a standardized approach will not work across multiple plants. Indeed, plants do often differ significantly, especially when a company produces a wide variety of products. Some have more complex processes than others; some are more automated than others, and so on.

However, it is possible to work around many of these differences to create an effective MES template. For example, a company with disparate processes across plants may be able to identify groups of plants that have common characteristics. It can then treat each set of plants more or less the same, thereby reducing the number of template versions that need to be created. Ideally, however, a company will want to have only one enterprise-wide MES template, which may be more feasible than one might initially expect.

For example, a company that produces the same type of chemical products in all its facilities, all based on a make-to-stock strategy, may find that it is fairly straightforward to have one MES template covering all sites, because of the similarity of production processes (such as raw materials intake, premixing, reacting, packaging) across plants. At the MES level, factors such as product definitions and reports can be standardized effectively, using industrial standards such as ISA-88 and ISA-95. Differences in plant equipment can be handled by the lower-level control systems. The MES layer can be used to integrate various control systems in a plant, even from different brands. MES can usually be configured on the parameter level, making it possible to accommodate minor differences at that level using the same overall template.

For other companies, implementing a single enterprise-wide MES template can be more complicated. A steel company, for example, might have many different kinds of processes in its supply chain. On the MES level, a sintering plant and a coke plant will have many similarities, but a hot rolling process in a separate plant on the same site will be quite different. Nevertheless, at an organizational level, they have certain commonalities: They are receiving production orders, preparing the production process, executing the work, collecting data and making reports. Most MES solutions offer enough flexibility in terms of configuration to allow companies to handle such situations, and model unique processes in a standard structure.

Nevertheless, local adaptations will almost always be necessary, because an effective MES system needs to be tightly integrated with Level 2 control systems that have a direct connection to a plant’s physical equipment. This need for tight integration for local adaptation underscores a fundamental difference between MES and ERP implementation projects: While business processes in offices can usually be altered to fit the standard processes in an ERP, it is not practical to rebuild a physical production line to comply with software. However, an MES template can be designed in such a way that individual local adaptations are significantly limited. Connections to a plant’s diverse equipment landscape can be handled through a local data historian, which is a database of detailed process-related data that has a real-time connection to a plant’s equipment control systems. The historian can be used as a layer between the standard MES solution and a plant’s diverse equipment.

To handle local adaptations, companies may be able to create one MES template that provides a superset of functionality covering a broad range of user requirements. Then, smaller or less-complex plants can turn off the functionality they do not need. In addition, this approach allows plants that do not yet have automatic data collection to participate in the MES by entering data manually. Later, when data collection is automated in these facilities, they will be well positioned to integrate their control systems with the MES. This approach also avoids the issue of developing a separate template to support lagging plants, and keeps all plants moving in the same direction toward one common way of working.

To a great extent, the effectiveness of a multi-site, multi-country MES template depends on leadership. It is critical to centralize responsibility for purchasing, implementing and supporting manufacturing IT systems, because local manufacturing budgets, operating independently, cannot take on the initial development expenses involved in the MES. Such centralization naturally requires the involvement of upper management, which ideally should create a central organization to oversee these IT governance tasks. Executives need to make it clear, right from the beginning, who is responsible for what and who is allowed to make which decisions.
Laying the groundwork

The creation of an MES template begins with the definition of a solid business case.

This exercise should cover the expected advantages, benefits and costs, and include a blueprint of the scope and overall functionality of the application. The business case should also compare the expected advantages of the template approach to the cost, effort and speed that would be involved if each site were to independently create and maintain its own solution. (See sidebar, “How the MES template can pay off.”)

The MES template needs to support the capabilities that differentiate the company, such as flexibility, cost, client service, or make-to-stock versus make-to-order. And it is important to clearly articulate how the MES will provide this support. Often, one of the larger challenges is providing top management with clear insight into how the template-based approach can help improve plant performance in line with company goals. If senior executives and the board of directors do not buy into the MES template concept, the effort is likely to fall short.

A long-term vision for MES is important. At the same time, however, it is important to recognize that circumstances will change over the years. Indeed, a company’s strategy may even be adjusted during the rollout of the MES template. Thus, it is important that the template design be flexible enough to adapt to such change. This flexibility is a key benefit of an effective template because once the MES is in place, a flexible, standard template puts a company in a better position to quickly implement new approaches in plants around the world.
Designing the MES template

After the scope and overall functionality of the MES have been determined, companies can start defining the template itself, based on an analysis of plants’ needs.

If the template covers a large number of plants, it will be impractical to analyze all in detail. Instead, companies can select a limited number of plants, with each plant representing a specific type of plant, such as “very complex,” “medium” and “very basic”; or “batch” and “continuous.” Information can be gathered from key users—plant managers, planners, supervisors, quality inspectors, etc.—at each of the representative plants.

In designing an MES template, teams typically will not have to start from scratch, because MES applications offer basic functionality that can be used as a starting point for a fit-gap analysis. As design work proceeds, the project manager must keep the emphasis on standardization and avoid customization. The goal should be to use 80 percent or more standard functionality for the enterprise template. In essence, any customization in the template is likely to create complications down the road. Also, templates can be built in layers that can be implemented independently. This type of phased implementation during the pilot can enable the effort to achieve visible successes sooner rather than later.

If the system is to be built at an offshore location, then it is extremely important that the specifications in the template design be completely clear: Programmers will not be able to walk over to the functional engineers’ offices to ask questions. Having someone from the core team coach the offshore team can help ensure the ultimate quality of the solution.

Figure 2. Governance of the multi-site template is essential to avoid local differences throughout the complete MES lifecycle.
Politically, it is valuable to have stakeholders experience the advantages of the new system as soon as possible.

When setting up a pilot, therefore, it is usually better to select a plant where there are many clear improvement opportunities, where there is not an effective local solution already in place, and where the full functionality of the template can be tested. This approach will help to highlight and clarify the improvements the new system brings. Similarly, it is wise to avoid plants where there is a strong resistance to change, and instead select a plant where there is recognized enthusiasm for MES. Once the pilot is successfully completed, the MES template can be rolled out, first to plants where the solution will bring the highest business value, followed by the other plants, so the manufacturing IT landscape is completely standardized across the plants’ network.

A key question that arises in implementing an MES template is where to actually run the software. Certainly, it may seem logical to have one central server that is accessed by all plants. Centralization is, after all, at the heart of the MES template concept. However, the system does not necessarily need to be centralized in a physical sense. In most cases, there are good reasons to rely on a series of local servers. For example, if the MES has a time-critical relationship with the process-control systems in the plant, the need to communicate with a distant server could introduce too much risk of disruption. One possible solution is to design the MES template so that time-critical functionality is pushed to the lower-level process control systems, which are managed at the local level. Another option is to centralize only the functionality that needs to be shared across plants, such as aggregated key performance indicator (KPI) reports. There is no absolutely right or wrong approach when it comes to making these server decisions. Each approach has its own advantages and disadvantages, and the best choice will depend on a company’s specific situation.

A robust interface between the MES and the ERP is also critical. Typically, companies should create an intermediate layer between the two where ERP data can be buffered. That way, plant operations are shielded from outages in the ERP system. In addition, interfaces should be carefully tested and validated in the pilot phase to uncover any issues, and identify any reporting errors or reliability problems. Testing should not be given short shrift: Problems in the template that are left unaddressed can have a far-reaching impact when the system is used in plants worldwide. Should problems occur after go-live, resolving these immediately will help build user trust and facilitate acceptance of the system.

Once the MES template is in use, companies should be prepared to provide ongoing oversight to help ensure that plants adhere to standards, and that excessive local variations do not take root. With that in mind, a company can set up a central MES competence center to provide that oversight, and to act as a second line of MES support. Local personnel will typically need to be the first line of support, because a rapid response to issues is critical to avoiding expensive downtime. The competence center should stay in close contact with these frontline personnel.

Clearly, there are a significant number of variables that need to be considered in designing and implementing a multi-site, multi-country MES template—from production processes to technical issues to the human element. Success will require time, resources and management attention. But the effort will likely be well worth it, and pay off in an improved ability to effectively manage the multinational plant network from a business-oriented, holistic perspective. And that perspective can ultimately help a company achieve high performance.
Implementation—and beyond

The following table illustrates some of the advantages companies might expect from a template-based approach to MES:

<table>
<thead>
<tr>
<th>MES Phase</th>
<th>Template-based approach</th>
<th>Non-template-based, single-site approach</th>
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</thead>
<tbody>
<tr>
<td>User requirements</td>
<td>Defined only once for the complete enterprise.</td>
<td>Every site defines its own requirements, and usually spends several weeks doing so.</td>
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<tr>
<td>specification</td>
<td>A mixed team with representation of key plants is usually involved in the pilot to secure coverage of the different requirements and future buy-in. This reduces overall design and maintenance effort by aligning processes up front as much as possible.</td>
<td>Process is repeated in each plant; thus, people and time are required to do the same or similar tasks over and over. Value-add for the company is questionable. There's also an increased risk of deviation in processes and requirements that should be common, creating higher maintenance costs.</td>
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<tr>
<td>Selection</td>
<td>Requests for information and requests for quotes need only be executed once.</td>
<td>Every site selects its own solution, and spends several weeks on this selection process. Duplication of project structure, limited or no ability to leverage subject-matter experts and lessons learned from plant to plant.</td>
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<tr>
<td>Design</td>
<td>One core MES solution is defined for groups of plants—or if feasible, for all manufacturing facilities in the enterprise or within specific clusters. This leads to significant efficiencies and economies of scale, with the ability to purchase licenses for different plants from one vendor.</td>
<td>Every site has its own solution designed. Limited or no reuse of knowledge or experience. Limited economies of scale when purchasing licenses from vendor(s). No focus on standardization that will enable benchmarking and operational excellence.</td>
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<tr>
<td>Implementation</td>
<td>The template can be tested and improved during a pilot implementation, and then rolled out in parallel to different plants. Benefits can be realized more quickly for the complete enterprise.</td>
<td>Every site decides on its own when to implement the solution. There's a risk of re-inventing the wheel in every implementation project. No lessons learned from pilot implementations.</td>
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<tr>
<td>Maintenance</td>
<td>A central competence center can support local plants, with only a few experts needed to work with a large group of plants. These experts “guard” the template, taking care that no local customizations or “dialects” negatively influence the advantages of the template.</td>
<td>Every site needs its own local expert(s) to support the MES system, and/or needs to define its own Service Level Agreements with local suppliers. For the enterprise, this means that many more FTEs are required to maintain the local MES solutions. Knowledge cannot be shared in cases where each site has selected a solution from a different supplier.</td>
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