Manufacturing Execution Systems

Who owns information systems in the plant?
For large manufacturers, the benefits of having effective Manufacturing Execution Systems (MES) in place are clear. But implementing MES can be a complex and challenging task.

An MES enables companies to "plan well and execute as planned," but reaching that goal is easier said than done. To be effective, an MES needs sound methodologies and applications infrastructure. It requires standardized key performance indicators (KPIs)—and the processes to monitor and act on those indicators. And it needs to be integrated with Laboratory Information Management Systems, control systems and other plant systems—and coordinated with the lifecycles and upgrade strategies of those applications.

An MES implementation also requires people with a "continuous improvement" mentality. Indeed, an MES implementation implies a transformation of the organizational mindset that aligns operators and managers with new streamlined production processes, and supports a dramatic shift from a qualitative to a quantitative approach.

Overall, then, the use of an MES can present a complex and multifaceted challenge that requires the right approach to training and enabling people; to coordinating processes, practices and systems; and to fine-tuning the organization. In short, an effective MES requires a sound, comprehensive approach to governance.

However, it is not always clear just what part of the organization should have responsibility for MES. In the ISA-95 standard classification of industrial applications, MES is part of the level 3 technology, or industrial IT (see Figure 1). This level is not yet clearly defined at most large companies; as a result, there is typically no formal definition of who should oversee these applications.

Figure 1. Industrial IT is associated with level 3 of the ISA-95 standard.

This diagram is an Accenture interpretation of the functional hierarchy model of ISA-95; see ANSI/ISA-95.00.01-2010.
IT and AT: Not ready for MES

While MES technology is clearly related to IT, AT operations people often believe that IT people do not know enough about production management to be effective in working with MES. For their part, IT people tend to think the same of AT people when it comes to information technology. A survey conducted in 2007 asked who should be responsible for MES inside the organization. The responses show that there is often no consensus about who should lead in this area (see Figure 2).

The survey respondents' comments underscored that reality:

• “It is becoming clearer that there is a need for a separate Manufacturing IT entity. Neither engineering nor IT can offer enough for effective MES functionality. We need a bridge and we can build that bridge by establishing a dedicated manufacturing IT group that combines IT skills with automation skills.”

• “The biggest challenge for an IT person is to think like a production person. For example, reliability between the four walls of a production plant is much more important than corporate efficiency. You cannot decide just like that on a Friday night to shut down the system for a few hours of maintenance. The engineers within our company are realizing that much more than the IT people. They are much closer to the reality of the production process.”

• “IT is not trained to help blue-collar personnel and give support for a 24x7 environment. To shut down an ERP system during a weekend for maintenance is okay for an office, but not in production.”

IT and AT each have strengths and weaknesses in terms of taking on responsibility for MES. For example, AT usually has better knowledge of manufacturing processes and real-time environments, while IT tends to have a better understanding of the global business vision, as well as core technology skills in areas such as networking and databases (see Figure 3).

The point is that neither IT nor AT has the full range of knowledge and skills needed to provide effective governance for MES. That means that companies need to create a group specifically focused on level 3 applications in general, and MES in particular. In the end, it does not really matter whether this organization is a part of the IT group, a part of operations/AT, or a separate group. What is important is having a dedicated entity with the full range of skills required to govern MES activities—that is, the right mix of technology knowledge and manufacturing perspectives and culture. And this group should have a solid understanding of industrial processes and maintain a 24x7 presence in the plant.

For most manufacturers, this dedicated entity represents an entirely new approach. To create such an MES governance group, they will typically have to prepare the existing organization that will oversee MES. If the MES governance entity is to be under the umbrella of either the IT or AT group, that group will have to be prepared to handle this critical MES governance role.

Figure 2. Who should be in charge of MES?

Demography

Does your company differentiate level 4 IT from level 3 IT?

IS MES in your company supported by...

How closely are IT and Engineering working together in your company?

Source: Bianca Scholten, “IT or Engineering...Which of them should support MES?” presented at ISA Expo 2007.
Figure 3. IT and AT readiness to receive responsibility for support of Industrial IT.

- Better level 4 APP knowledge
- Centralized management
- Global vision aligned with business
- Operates with low total cost of ownership
- IT skills: network, databases, etc.
- Ability to manage infrastructure
- MES patterns and concept knowledge
- Ability to support applications professionally
- Familiarity with the infrastructure required by MES
- Presence in the plant
- Experience in real-time environments
- 24x7 plant support
- Better knowledge of manufacturing processes
- Better knowledge of level 1 and 2 applications
Preparing AT for MES governance

AT’s strengths lie in its ability to provide a critical production-oriented perspective to MES. The problem, however, is that the processes used by AT to manage MES technology are usually not as formal as those used by IT. To a great extent, preparing AT for MES means adopting some of those more-rigorous IT processes.

In general, IT departments have a higher governance maturity level than AT groups do (see Table 1), due largely to their focus on infrastructure and application standardization to reduce complexity and cost. With an emphasis on “running IT as a business,” IT typically measures, evaluates and continuously enhances the services it provides to the company. As a result, internal IT processes tend to be well defined.

AT groups, on the other hand, usually spend little time describing their processes and procedures. In some cases, AT is not organized as a formal department or division; instead, there is an automation committee made up of personnel from across the plant. When an AT department does exist, it is typically placed under local operations or local maintenance in each plant, without any centralized management at the company level. This plant-oriented structure can limit AT’s performance and its capacity to think strategically. It is a large part of what makes it so difficult to standardize automation assets, applications and procedures, and why it is so difficult to connect IT with shop floor applications.

The good news is that the path to improved AT governance is clear. Companies can draw on the IT department’s proven methods for managing IT, and apply well-understood governance practices and support standards such as COBIT and ITIL.

Companies can follow a clear, multi-step approach to automation governance (see Figure 4). This approach begins with an assessment of existing processes, which provides a foundation for the definition of an operational model for governance. This model can be a fully centralized, decentralized or federated one. Some centralization is always necessary to cover processes such as standardizing assets and applications, defining automation procedures and technical architectures, and developing global master plans and automation templates. All roles and responsibilities should be defined up front. Ultimately, this work should lead to plans for change management and taking action.

A key decision in this process is whether the centralized organization or the local plant will be responsible for suggesting new projects, supplying and controlling the automation budget, and managing the project portfolio. If the central group controls too much, the structure tends to be rigid and lose leanness and escalation capacity. This tendency can be alleviated by letting each factory have its own automation budget, depending on its size, growth capacity and profitability. At the same time, it is typically a good idea to centralize the training budget to help ensure that everyone in the organization receives consistent, adequate training. In general, the determination of norms and standards should be under central control, while operational activities should be managed at the plant or regional levels.

Figure 4. Phases of an automation governance project.
Table 1. Typical IT and AT governance maturity in manufacturing enterprises.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>IT</th>
<th>AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralization</td>
<td>Centralized management</td>
<td>Decentralized management</td>
</tr>
<tr>
<td>Management</td>
<td>CIO, generally subordinate to the VP of Finance</td>
<td>C-Level involvement generally nonexistent. Higher hierarchical levels represented by managers, subordinated to the operations/maintenance area.</td>
</tr>
<tr>
<td>Formal process definition</td>
<td>Well-defined and managed processes; running IT as a business</td>
<td>Processes not formally defined</td>
</tr>
<tr>
<td>Governance</td>
<td>Well-defined governance</td>
<td>No formal governance definition</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Good infrastructure management, often outsourced</td>
<td>Improvised infrastructure management</td>
</tr>
<tr>
<td>Standardization</td>
<td>High standardization of applications and assets. Low total cost of ownership</td>
<td>Automation assets not standardized. Scattered applications landscape, many different vendors and technologies from different eras. High total cost of ownership.</td>
</tr>
<tr>
<td>Project portfolio management</td>
<td>Centralized portfolio management</td>
<td>Portfolio management is distributed throughout the plants; diversity increases</td>
</tr>
<tr>
<td>Medium-term planning</td>
<td>Most companies develop a strategic management plan</td>
<td>Most companies are developing Automation Master Plans every five years</td>
</tr>
<tr>
<td>Alignment</td>
<td>Projects very aligned to the business</td>
<td>A culture that justifies projects based on business cases is usually not in place. Projects are often initiated from a technical perspective.</td>
</tr>
<tr>
<td>Budget</td>
<td>IT investments represent about 5 percent of company revenues</td>
<td>Negotiated year by year and fully dependent on investment cycles. Often part of the plants’ maintenance budgets without visibility into which part of the budget is devoted to automation.</td>
</tr>
<tr>
<td>Obsolescence risk</td>
<td>Low. Applications are updated periodically.</td>
<td>Medium to high. Asset replacement cycle is very long.</td>
</tr>
</tbody>
</table>

Source: Accenture.
Preparing IT for MES governance

To make IT ready for MES governance, companies need to define a new group within IT that is dedicated to industrial IT activities—an “Industrial IT” group. (This approach assumes that IT is already well organized and able to manage IT as a business. If this is not the case, the overall IT organization needs to be brought up to speed before the Industrial IT group is created.)

The Industrial IT structure should be based on a formal governance blueprint, with processes, roles and responsibilities and contact points with other organizational levels all being well defined. The group should be guided by rigorous, manufacturing-oriented service-level agreements with the business. It should “talk the factory language,” and understand production processes, priorities and limitations. Much of the required IT work can be done remotely, of course, but experience has shown that operations personnel will not truly trust IT people who do not have a presence on the shop floor. In addition, when plants have an operational issue, they cannot afford to have the issue entered into an IT work queue or wait for the next global MES template to be released. Production problems are often urgent; operational personnel are not likely to wait for IT if there is a delay, but rather come up with their own pragmatic solutions on site. Overall, then, a local IT structure and presence are a necessity.

In creating the Industrial IT group, companies should draw on technology professionals and automation specialists working the traditional IT and AT areas. A hybrid mix of the two specialties can be created through training and experience over time. In some countries, universities have created a formal degree that focuses developing professionals who specialize in managing MES and level 3 technologies.

Companies also need to decide where to place Industrial IT on the organizational chart (see Figures 5 and 6). It is usually placed under the CIO, in parallel with corporate IT, but it can also be placed under the COO in parallel with AT. Another option is to have Industrial IT, Corporate IT and AT located at the same level under the CIO. This can be difficult, however, because CIOs are generally not comfortable with automation-related responsibilities. Often, they feel that they do not have the right factory experience and are concerned about becoming responsible for production maintenance. This is not an entirely valid issue, however. While the CIO might have responsibility for central AT governance, there are typically non-centralized groups with deep manufacturing knowledge in place that can be responsible for on-site activities.

### Figure 5. The CIO is responsible for Industrial IT and for Central Automation.

#### Centralized structure

<table>
<thead>
<tr>
<th>VPs</th>
<th>CIO</th>
<th>Corporate IT</th>
<th>Industrial IT</th>
<th>Central automation</th>
</tr>
</thead>
</table>

#### Local structure (under the general plant manager)

- Regulatory and management functions:
  - Define standards for equipment and applications.
  - Define methodologies.
  - Define global suppliers and agreements.
  - Manage projects’ portfolio.
  - Manage global templates.
  - Manage automation indicators.
  - Manage knowledge.

- Execution functions:
  - Perform site systems maintenance.
  - Suggest automation projects.
  - Manage project implementation.
  - Manage automation teams.
  - Provide first-line support.

### Figure 6. The COO is responsible for Central Automation.

#### Centralized structure

<table>
<thead>
<tr>
<th>VPs</th>
<th>CIO</th>
<th>Corporate IT</th>
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</table>

#### Local structure (under the general plant manager)
Once these structural issues are resolved, companies can concentrate specifically on MES project governance. Here, a fundamental first step is not the selection of an MES product, but rather the development of an MES Blueprint or Global MES Template that defines what needs to be implemented. To do this, companies need to identify the team that will develop and implement the project. It is also important to create an internal structure for leading the project. For example, if IT/Industrial IT is going to lead the effort, companies can set up a steering committee that includes IT professionals, a key user from each site and from each product category, a representative of the MES consulting team and automation specialists. If there is a Lean Six Sigma program, Perfect Factory program, Operational Excellence program or other production improvement initiative in place, a member of that program should also be invited to be on the steering committee.

There are several key factors to bear in mind when defining the project governance approach:

- **Align project and sponsor expectations.** If possible, have an executive committee oversee the steering committee. In any case, document client objectives and expectations and keep C-level executives informed of MES progress.

- **Keep AT/operations in the loop from the beginning.** Operations and automation personnel are often more concerned with keeping production up to speed and reducing downtime than providing vital information to upper levels of the organization. These groups should be part of the MES initiative and understand that their role in providing information is crucial to the project’s success. They should also participate in KPI definition and in efforts to reduce the number of connection points to the plant floor architecture.

- **Focus on compliance.** When defining the functionalities map and the body of the MES Blueprint, focus on compliance with prevailing standards such as ISA-95 and ISA-88.

- **Define and standardize KPIs, reports and master data first.** The definition of a seemingly simple metric such as Overall Equipment Effectiveness (OEE) can actually be quite complicated. For example, OEE can be measured by dividing the production of “on-spec” parts by the expected nominal production. But that simple definition provides no drill-down capability and makes it impossible to analyze OEE in detail in order to drive improvements. Each OEE component—physical availability, utilization, performance, quality, etc.—should be precisely defined for each production unit or line. This “information engineering” work can be part of the blueprint effort, or the two efforts can be done in parallel.

- **Plan to accommodate diverse sites and categories.** For example, a good solution for a steel plant will not necessarily be right for a wire factory at the same company. If plant differences are too significant to accommodate with a single version of the solution, more than one MES implementation will be necessary. As a rule, however, it is very important to maximize core functionalities and minimize category and site-specific development (see Figure 7).

The role of the steering committee will continue even after the first go-live. For example, after the system goes live, plant personnel will ask for new functionalities. This can be a good indication of MES acceptance, but steering-committee guidance is needed to make sure any changes are useful and aligned with the company’s larger needs. In general, the steering committee needs to be involved in MES versioning administration and in measuring the implementation results. It should also be responsible for organizing the centralized help desk, educating factories not yet on the MES solution, administering change management and investing in improvements and new releases.
Conclusion

MES can bring significant benefits to manufacturers, but achieving those benefits depends on taking the right approach—on factors such as ensuring standardization and consistency and providing the oversight needed to help the organization succeed with MES. All of this makes good governance a critical element when implementing and managing an MES initiative.

To build an effective governance structure, companies will need to look beyond the traditional IT and AT groups. They will need to create new entities that draw on those groups to bring together the right skills and knowledge. This perspective represents a significant departure from past practices, and it will require new approaches and a willingness to change. But it is likely to be well worth the effort. There is an axiom in manufacturing that says “implementing production management improvements is a journey, not a destination.” With MES, governance is the key to guiding that journey so that it produces the benefits the company expects.

About the authors

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