Building Your **MES Team**

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Abstract

Making the decision to implement a Manufacturing Execution System is a big step for any company. Generally, this means that an organization is comfortable with allowing an integrated manufacturing system to manage its production orders. Therefore, finding the right resources to manage this system is just as important as choosing the right system. This article first addresses the differences between Information Technology and Manufacturing Information Technology and then discusses how to build the team of Manufacturing IT professionals responsible for managing a shop-floor system.
Table of Contents

About the Author 2
The Intended Audience 2
Introduction 3
What is Manufacturing IT (MIT)? 3
Fitting MES into your IT Organization 4
Learn from not Copy the “Best-in-Class” 5
The MIT Organizational Structure 5
Building your MES Team 6
MES Team Member Job Functions 7
Working with your Service Vendor(s) 8
Alleviating the Preverbal “Rub” 9
Insulating your MES Team 9
Conclusion 11
Summary 12
Sources Cited 12

About the Author

Frederick K. Johnson has more than 10 years of experience as an MES Systems Engineer, implementing and supporting Manufacturing Systems. Frederick, who holds a BA in economics and a master of education in instructional technology, has worked for some of the top Fortune 50 companies in the United States, with names like DaimlerChrysler, The Coca-Cola Company, Hyundai Motor Manufacturing Alabama LLC, and Tyson Foods Inc. With both domestic and international industry experience across Food & Beverages, Automotive, and Pharmaceuticals, Frederick currently holds a position at B | Braun Medical Inc., the world’s 11th-largest pharmaceuticals manufacturer, as a Project Controls Engineer.

The Intended Audience

Provide “decision makers” within an organization a good understanding of the differences between General IT (IT) and Manufacturing IT (MIT).

Then to convey why understanding the evolution of MIT can assist their organization in defining what MES means in general. There are many obstacles a manufacturer can fall victim to by employing a “copy & paste” methodology when implementing an MES. Companies should take the time to understand “why” and “how” MIT has evolved into its current form.

After establishing that foundation, an organization should define what both MIT and MES will represent in terms of their business needs, goals, and objectives. All of this will, eventually, lead to “building your MES team” to support your shop-floor systems.
Introduction

It is no big secret that Manufacturing Execution Systems (MES) are changing how manufacturing companies run their businesses. Integrated manufacturing may have its roots in the auto industry, but MES has quickly become commonplace in many industries. Proven systems like MES are tools used by companies rated “best-in-class.” Macher and Nickerson recently studied a group of 42 pharmaceutical manufacturing facilities and confirmed what the auto industry has known for over 30 years now.

“... use of Information Technology (IT) almost universally corresponds to achieving superior manufacturing performance metrics. By IT, we mean those investments that enable manufacturers to electronically and automatically report deviations; track deviations by lot, by type of issue, and people assigned to resolving the deviation; and the central storing of data to facilitate problem solving.”

In this study, Macher and Nickerson correctly describe the core functions of a Manufacturing Execution System. Then, just as most people would do, the two place MES into the field of Information Technology (IT). This may seem like a trivial point, but it is precisely the point I want to make, only because MES and MIT are both obscure as concepts and as branches of IT.

What Is Manufacturing IT (MIT)?

The not-so-well-known MES, theoretically, falls under the even less well-known Manufacturing Information Technology category.

Manufacturing Information Technology is an area within the field of Information Technology. MIT professionals manage information technology & systems used specifically in a manufacturing or shop-floor environment.

General IT professionals, unlike their MIT counterparts, manage business systems like those most people use in a traditional office setting. In order for an MES to function correctly, it will require an infrastructure connecting a hierarchical group of networked servers and its clients, both centralized & decentralized data-collecting repositories, ERP & shop-floor DCS network interfaces, and finally web services used as its MES end-user interface.

“Business Systems and Manufacturing Systems use the same General IT concepts, tools, and methods; however, the two use these concepts, tools, and methods differently to manage their systems and sometimes for entirely different reasons than the other.”

Even though none of the above sounds any different from a front-office setting, shop-floor systems are definitely “mission-critical systems.” Why? E-mail systems do not manage an organization’s production orders, yet an MES will. If e-mail services abruptly stop during a production period, business users simply pick up their phones, but a sudden halt of MES services during that same production period sends a ripple effect across the entire manufacturing operation. Hence, General IT is typically tied to the manufacturing offices while MIT is tied to the manufacturing shop floor.

In most manufacturing companies, the shop floor, not the front office, is where the company generates its revenue. If a manufacturing company is not running during a scheduled production period, the organization is losing money. As a result,

IT and MES System Engineers build, support, and manage front-office and manufacturing systems differently because one has a much greater impact on the company’s bottom line than the other.

MIT professionals understand how to apply common General IT concepts and
methods like Domains, VLANs, and Access Control Lists on the shop-floor network. For example, any experienced MES Systems Engineer recognizes that Dynamic Host Configuration Protocol (DHCP) may cause very serious communication issues if enabled. In contrast, General IT professionals in front-office environments would see some of the above as outright ridiculous because many of these concepts, tools, and methods, like DHCP, are necessities in their world.

Any manufacturer planning to implement an MES must have a clear understanding of the distinctions between General IT and MIT. This is especially important for the Human Resource Manager or the person charged with building a team to support a Manufacturing System. In this case, knowing the differences between General IT and MIT may mean the difference in finding or not finding the correct resource(s) to manage your MES investment.

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Fitting MES into Your IT Organization

The missing Manufacturing IT voice and MIT’s lack of presence within the IT organizational structure are two of the biggest problems I see regarding MES.

Many organizations, excluding those within the auto industry, place their Manufacturing Execution Systems under Business Systems within their IT organization. Sure, it sounds great and it may look like this is where MES belongs, but from my point of view, this is only half correct. I have personally managed manufacturing systems from both sides of the fence, from the Business side and from the IT side. Supporting an MES from a dedicated MES team, within IT and under an MES or a Manufacturing IT department, is the most efficient and effective method of managing an MES.

Misplacing the MES in your organizational structure gives rise to many “production related” problems because manufacturers:

1. place the MES supporting functions under General IT and the plant’s IT team has little experience managing shop-floor systems;
2. hire MIT professionals, but place them on the Business side where they become “advisors” and not hands-on agents of change; or
3. hire MIT professionals into the organization, but stronger IT and/or Engineering opinions overshadow the MIT voice.

Any company serious about implementing an MES should consider that implementing an integrated manufacturing system might require changes that include:

1. A place within the current IT organization structure under MIT with
   - autonomy
   - defined responsibilities
   - a reporting structure that fosters integrity
2. MIT leadership that
   - provides vision
   - has a voice in the production decision-making process
   - has subordinates to cover all production shifts
3. Hiring MIT team members
   - Director
   - Manager
   - System Engineers
   - Technical Support Analysts
4. Giving MIT a budget in order to support and sustain the entire MES
Since MES is new to so many organizations, this type of structure is hardly considered. Human Resource Managers toss MES into the IT department, thinking that their current organizational structure is adequate to handle “this new software package we’ve just installed.”

An MES is much more than software, but with the lack of understanding, organizational structure, preparation, or experienced MIT professionals, the perfect storm brews on the horizon. When the storm passes, what remains in its wake are production outages and lessons learned. And just as in other areas of life, these lessons are learned by trial and error. Eventually, production outages and increases in direct costs will force organization structures to evolve into properly organized business units. Manufacturing systems teams, like those in the auto industry, will come into existence with explicit assignments to support these systems directed to preventing costly mistakes from reoccurring.

**Learn from, Don’t Copy, the “Best-in-Class”**

The auto industry has been on the leading edge of MIT for years, and smart newcomers to MES have learned how to capitalize on the evolution of MIT in terms of “best practices” refined by the likes of Toyota, Ford, General Motors, and DaimlerChrysler.

**Learning the evolutionary “how’s” and “why’s” behind implementing an MES is one thing. Understanding and defining “what” MES will mean to a specific organization is something entirely different.**

Once an organization completes its due diligence by defining what MES represents to them, creating a path to arrive at that vision becomes the next order of business. At this point, examining established MIT methods employed by those considered “best-in-class” is a reasonable option. The main idea, though, is not to “copy & paste” these methods but to learn from them.

**Generating an MIT path that is unique to an organization and based on proven MIT methods is an effective way to achieve your MES final state in a very short period.**

Intelligent manufacturing companies, including the Asian-based automaker Hyundai (parent company to KIA Motors), have done this for years. Toyota, Ford, General Motors, DaimlerChrysler, and Hyundai all have distinct shop-floor groups that are clearly different in function and responsibility from their front-office IT colleagues.

Hyundai went a step further, by arranging its North American Information Technology groups into a separate company called **Hyundai Information Services North America or HISNA**. Within HISNA there exist many IT groups, with one group exclusively covering Manufacturing Execution Systems. The MES group has a structure that supports integrity, its own leadership, definitive responsibilities, and functions totally apart from General IT. HISNA subsequently breaks down the MES groups into plant teams that provide MES support for its two North American manufacturing facilities — Hyundai Motor Manufacturing Alabama LLC (HMMA), located in Montgomery, AL, and KIA Motor’s Manufacturing Execution Systems, located in West Point, GA.

**The MIT Organizational Structure**

Hyundai’s example demonstrates how building a team to support a manufacturing system means that the resources within that team have a home
Building Your MES Team

As simple as this may seem, this point very rarely comes up in the discussion of implementing an MES. The consensus is that MES is an IT function. Therefore, the correct question is not where to place the MES group but where to place the MES group within the current IT structure.

It is my professional opinion that the support of MES should be placed under the current IT organizational structure in a Manufacturing IT group with a name related to supporting manufacturing systems that include MES. The “best-in-class” manufacturing companies all implement some variation of this type of structure. It really is that simple; however, some organizations still do not get it.

Building Your MES Team

Once the MES organization is in place, defining the players within that group is very important. Based on my experience, here is the most basic team structure:

- MES Director
- MES Manager
- MES System Engineer(s)
- MES Technical Support Analyst(s)
- MES Solution Service Vendor(s)
- Third Party Service Vendor(s)

Nearly every company that I have worked for eventually moves to this type of team structure. Organizing the MES team in the above manner approaches the optimal team functionality. Of course, determining what is best for any company depends on the size, the number of shifts, and the technical complexity of the manufacturing facility.

One of the most effective ways to build an MES team is to stagger in the team members at the appropriate phase of the MES implementation project. The MES Director and Manager are the primary key resources needed to create, initiate, and manage the entire MES project. These two individuals will lay out the project foundation from the conception of the MES vision to implementation into production. It is a very good idea to hire on the MES Systems Engineers after selecting the MES solution provider. The MES Systems Engineers should have detailed knowledge of the MES contract and the MES solution functionalities; they will also need to engage each production team to collect key MES requirements.

As the project moves forward through each phase, the MES Systems Engineers will gain the specific system-related knowledge they will need to support the MES solution and to train the MES Technical Support team members. Establishing a good relationship with the solution providers will also come in handy because these entities will later become the organization’s Service Vendors.

When the project reaches the Facility Acceptance Testing (FAT) or the Site Acceptance Testing (SAT) phase, hire on the MES Technical Support Analysts. Team members at this level receive their training from the MES Systems Engineers. Actual classroom training is great.

Training for inexperienced resources

- General MES concepts & principles
- General manufacturing principles
- Control-room operations
- Help-desk principles
- Advanced networking
- Managing local area networks
  - Network equipment (HW)
  - Servers (HW/SW/OS)
  - Clients (HW/SW/OS)
  - Network printers
- Managing client/server applications
- Distributed database systems
- Web languages & services
- Team conflict and resolution
  - Communicating
  - Interpersonal skills
The above are just a few areas to cover, although the most effective training is “learning by doing.” This is why bringing these team members on during the FAT or SAT is so important. The MES Technical Support Analysts must be involved 100% at this phase because here is where they will learn their day-to-day duties. Place the MES Technical Support Analysts in charge of uncovering flaws in the system under the supervision of the MES Systems Engineer. If an MES Technical Support Analyst can identify system flaws, issues, and inconsistencies during the above phases, supporting the entire system in the near future will not be that big of a leap.

**MES Team Member Job Functions**

The MES team’s chain of command obviously starts with the MES Director as the team lead and ends with the MES Technical Support Analyst as the lowest-level subordinate. The MES Solution Service Vendor(s) and the Third Party Service Vendor both play major roles, but these are service contractors, not full-time employees.

**The MES Director**

The role of the MES Director is to provide vision, leadership, and direction. Here is where that “MES voice” I spoke about previously comes into play. Providing direction to the MES team is a given; providing direction to the manufacturing organization is essential! After implementation, the MES will be regarded as a mission-critical system. In other words, the plant will not be able to function without it. With this in mind, the MES Director must have a “voice” with which to inform, suggest, and provide their professional opinion concerning paths the organization wishes to take. The Director must give assurance that the current MES state will accommodate any future production paths. When there are red flags, the MES Director voices their opinion to address those issues.

**The MES Manager**

The MES Manager has the most contact with the entire team. This role assigns project tasks and duties to all the subordinates and monitors their progress. Some companies may not require an MES Director; in those cases, the MES Manager would act as both Director and Manager within the department. A key responsibility in this role is making sure the project tasks are completed on time and under budget. Time scheduling, training, and providing status reports to upper management are additional core functions of the MES Manager.

**The MES Systems Engineer**

The MES Systems Engineer performs the bulk of the technical, system-related, and supervisor-type functions. Consider these individuals to be second- or third-level support. The MES Systems Engineer will scrutinize all manufacturing systems in terms of design and functionality. The Systems Engineers are responsible for making sure that the solution provider meets all key business requirements. They will also perform many of the following duties:

- Requirements gathering
- Authoring requirements documents
- MES network design
- Systems installation & configuration
- System testing & debugging
- Managing software updates
- Managing project phases
- Team member & end-user training

It would be an excellent idea to have a diverse group of engineers with some having expertise in programming, networking, system design, and PLC/DCS & controls. Having a wide spectrum of
skill sets provides a deep talent pool to draw from.

Regardless of the engineers’ other expertise, extensive experience in supporting Manufacturing Systems is mandatory. This point cannot be stressed too strongly. A shop floor may have hundreds if not thousands of loud, fast-moving pieces of equipment. Robots with articulating arms and conveying systems with roller beds are especially dangerous. Some process equipment have their connections terminated in IDF\(^{s}\) (intermediate distribution frames) located in the ceiling while others are behind gated fences. Troubleshooting any system-related problem may require the MES Systems Engineers to examine connections in remote areas of the facility, and doing so safely is a very important skill.

Knowing how to get around in a manufacturing environment without injury is something a person learns through experience.

**MES Technical Support Analysts**

The everyday duty of supporting the facility falls on the shoulders of the MES Technical Support Analyst (TSA). These roles will generally monitor the activity of the facility from a central control room. Within the control room, the MES TSA will communicate with production team members and with the MES Systems Engineer concerning any type of problem. The MES TSA typically remains in the control room and performs routine duties related to system maintenance within that control room.

**Working with Your Service Vendor(s)**

After the MES project has moved into production, the Service Vendors are the entities that will correct any problems covered under the warranty contract. These contractors installed the equipment and ran the wires and cabling and will be called in to deal with problems like hard-drive failures, monitors burning out, software issues within the MES, networking problems, and so on.

The Third Party Service Vendors are the companies who sold the installed equipment like the computers and the servers to the contractors. The solution provider purchases this equipment to install but places the warranty of this equipment on the equipment manufacturer. If there is a problem with the purchased equipment, the team must go through a Third Party Service Vendor who works for the OEM to resolve the problem. The MES Systems Engineer will work very closely with all the Service Vendors.

One major point I want to stress is that the MES team needs to be very careful in working with Service Vendors. Most integrators make their money off servicing their clients, not off the installation. Therefore, understanding what is and is not covered under the systems warranty is critical. Without this understanding, your team could pay thousands of dollars just to have someone come in, reboot a server, and restart a service. This is something any team member could have done. Here are a few suggestions to keep in mind:

1. Verify that all Service Vendors have signed the proper legal documents like non-disclosure agreements.
2. Know the coverage for all your service level agreement (SLA) & warranty contracts.
3. Establish a “change control” process and a service procedure.
4. Create a Service Vendors document outlining your contracts and all the Service Vendor detail information.
5. Establish an understanding with all Service Vendors by training them on your MES service procedures.
6. Follow the service and change-control procedures and process.
7. Monitor all Service Vendor activity.
8. When the service call is completed, document all activities in the change-control document and close out.
9. Update the service procedures when an SLA changes (if needed).
10. Management should verify all invoices before approving payment.

The truth is, whether you have ten points to follow or a hundred, expensive service calls can quickly put a dent into any budget. What I want to make clear here is that the MES team should intensively manage their Service Vendors. The best way to do that is to create a documented process from incident to resolution. By documenting issues and monitoring the Service Vendors, the Engineers can learn the corrective measures for a particular problem and the in-house team can solve that problem on its own in the future. On more complex programming issues or customized solutions, the Director and the Manager should manage these changes, only because of the potential cost, surround programming, and custom changes. The MES Systems Engineers should make sure that the corrections are complete and meet the organization’s requirements.

Alleviating the Proverbial “Rub”

No matter how we slice it up, MES will always be in the middle. There is no way around it; MES is firmly lodged between the ERP system and the Controls level. Sometimes, being in the middle means that there are overlapping boundaries and responsibilities between business units. This overlap may cause the proverbial “rub.” Essentially this occurs when job functions, roles, and responsibilities are not clearly defined between employees and/or business units. The best way to alleviate any friction between IT, MES, and the shop-floor Controls Engineers is to define boundaries and responsibilities between the groups up front.

Definite boundaries exist within a plant’s information system, but all too often no one takes the effort to formally define them until it is too late and the confusion and finger-pointing have begun. Trust me, an organization can save itself major headaches by defining what those boundaries and responsibilities are up front. Preventing friction between IT, MES, and the shop-floor Controls Engineers is well worth the time spent.

Even if there is a lack of defined boundaries, the MES team has a responsibility to become a liaison between the groups. This may not seem fair; however, manufacturing systems affect just about everyone in the facility in some shape or form. For this reason, MES team members must have approachable personalities and excellent communication skills. These skills will allow them to act as liaisons to the business. On occasion, MES Systems Engineers may find themselves explaining a problem to the president of the company one minute and training a shop-floor operator the next. This is a very important criterion to keep in mind during the hiring process. If a team member does not have effective communication and interpersonal skills to engage their customers, this part of the job may present a challenge.

Insulating Your MES Team

Companies make capital investments for one reason and for one reason only: to become more profitable in a competitive market! Is this not why people go into business, to make money? Of course it is! Manufacturing companies are very pragmatic; they pay for performance that meets or exceeds business objectives. In my opinion, this is where...
things become very interesting in the world of MES.

Implementing an MES will fit into an organization’s business objectives. It has to, or else the business would not spend millions of dollars to do it. For most manufacturing companies, MES streamlines the manufacturing process and collects the data that reports out the “manufacturing intelligence” used to drive the business. There are many other benefits, but at the end of the day it is all about the money.

As the role of the MES becomes clearer, the power of the system becomes evident. Production teams begin to understand that everything is accounted for and the days of fudging a few figures here and there are long gone. This is the time when people start to “get it.” The MES is then seen as a system that is capable of tracking every manufacturing operation. Production staff realizes that the system will collect and record production-level data without any human intervention. This collected data will subsequently generate performance reports used to drive the business or drive people out of the business. This last point will make some people very nervous, because the MES has essentially leveled the shop-floor playing field. The hammer will swing when finance starts asking questions like

- How much are machine failures actually costing the organization?
- Why is OEE so low?
- Why are yields lower than expected?
- How do we determine whether capital projects are realizing their returns-on-investment as Engineering stated they would?

In a pre-MES environment, the production business units were the ones answering those questions. Trust me when I say that this was a huge and sometimes sensitive problem, particularly when careers, promotions, and bonuses teetered on the outcome. As you can imagine, subjective behavior and politics both influenced what a business unit reported out, not objectivity.

After a Manufacturing Execution System’s implementation, finding answers to the relevant questions becomes a matter of statistical calculation. The MES reports performance based only on the data that it collected during the scheduled production run. Subsequently, business units must promptly justify any process deviations. The MES team has very little to do with justifying deviations, outside of making sure the system is available. My point here is that as the pressure mounts, individual careers may lie in the balance. The MES team should be free from any external pressure to tamper with or make erroneous reports about production performances.

There are specific reasons why, after 30 years of experience, manufacturing systems teams in the auto industry do not report to the facility leadership. Instead these teams tend to be “corporate employees” assigned to support a specific facility. The facility staff and local IT teams do not have access to the MES central control room, access to the MES network, or any authority over the MES support team at all. It is the corporation which the team reports to, generally a chief information officer (CIO). This kind of reporting structure fosters integrity by removing the threat of external pressure to manipulate data used to calculate a facility’s production performance. An organization should think long and hard about this point. If a facility is making erroneous claims to inflate its performance, and altered data supports those statements, such behavior could have serious consequences on expected revenue from meeting market demands.
Conclusion

If there is any one thing I would want readers to take away from this article, it is that what MES is and will become at any manufacturing organization is purely speculative and relative at best. Not only that, but MES will continue to develop and morph as new technologies emerge and the organization changes due to market conditions – this much is true.

Making the decision to implement a Manufacturing Execution System means that an organization is ready to switch gears in the way that it thinks about technology and is comfortable with allowing an integrated system to manage its shop-floor orders.

After implementation, the MES will report the truth on production performances. How an organization deals with the truth is another discussion. These are big steps for “newbies” to MES.

Still, if you are having problems pulling it all together, try looking at it this way. Just about every person I know has, at some point in his or her life, dreamed of owning an exotic car. However, what many of us fail to plan for or understand are all the things that go into making the exotic vehicle perform correctly, right? The exotic-car salesperson assumes you know what you are getting yourself into and does not make any attempt to persuade you not to buy the vehicle. For those of us who have done our homework, tallying up the real cost of owning that exotic car — the maintenance costs, storage fees, and car insurance — is a sobering experience.

Implementing MES is no different, but cost is only one of many dimensions to consider. An integrated system like this wraps itself around the current business and manufacturing processes like nerve endings. It continuously monitors and collects impulses regarding states or conditions of process equipment and machines on the shop floor. It then turns those states or conditions into data. This data is aggregated at a decentralized level, is then passed around to update other systems, and is finally stored at a centralized level to be used throughout the system for analysis. Just like the exotic car, the MES assumes that your manufacturing organization is ready and able to handle whatever it takes to integrate MES into its current manufacturing process. MES assumes that an organization has the capability to sustain and to support its functionality in order for it to help the business achieve its objectives.

Automakers started building these types of systems in the late 1960s and have since perfected MIT into a science. Through years of experience and millions of dollars, Manufacturing Execution Systems have evolved into fully matured and viable systems that allow manufacturers to stay competitive by increasing quality while reducing cost.

Looking to the “best-in-class” for MIT answers does not mean blindly doing what they do.

If there was ever a wrong way of implementing an MES, this has to be it! This discussion is not about how to apply a copycat method in building an MES team. Rather, the intent of this discussion is to provide a basis for understanding the differences between General IT and Manufacturing IT and to then encourage the decision makers within an organization to think about how MIT has evolved over the years to its current state. As decision makers take that evolutionary journey, the pitfalls that loom for any company taking steps towards implementing an integrated manufacturing system become obvious. That knowledge, coupled with a basic understanding of MIT, allows an organization to begin to define what MIT and MES mean in terms of their specific...
needs and not the needs of the “best-in-class.” Only under this type of framework should a manufacturer even begin to think about building an MES team.

Summary

Any organization can fully realize a sound MES vision by following a carefully orchestrated path that first outlines the organization’s business needs and then applies proven MIT methods or solutions to address those same needs. With more than 30 years of MIT evolution and with huge advancements in technology, feasible, cost-effective, and technically mature solutions are readily available.

Prosperity is in reach for those who:

1. Take the time “up front” to learn the differences between IT & MIT in order to understand how to apply proven MIT concepts, principles, and methods

2. Define a working MES model in respect to an organization’s business needs and objectives

3. Create an organizational structure where MIT and MES can best serve the organization by supporting and sustaining the MES

4. Build a team of experienced MIT professionals dedicated to sustaining the MES, so that the business drives towards its current and future objectives

5. Seek out solutions to solve specific problems that fall outside the boundaries of the constructed MES model

6. Finally, leverage the true power of the MES, in all aspects. Use the production-related data generated by the MES to find cost savings through “lean manufacturing concepts & principles”

Sources Cited


