The Future of Manufacturing Execution Systems...

The Brave New Modular World of Manufacturing Intelligence

Abstract

As the world of manufacturing continues to evolve on its race to zero defects through the use of tools like Manufacturing Execution Systems or MES, the concepts and principles used within the current MES model and how MES Solution providers develop, market and sell their MES products are changing as well. This paper discusses how the changing landscape of business, increased market competition and how the effects of stricter governmental regulations, specifically within the Pharmaceuticals and advancements in medicines, are driving forces behind modular MES solutions and the reclassification of MES as the engine behind the concept of Manufacturing Intelligence.

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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 from Marquette University, a MS Ed in Instructional Technology from Cardinal Stritch University and a MS in Computer Information Systems from Boston University (2012), has worked for some of the top Fortune 50 companies in the United States, with names like DaimlerChrysler, Hyundai Motor Manufacturing Alabama LLC, The Coca-Cola Company, and Tyson Foods Inc. With both domestic and international industry experience across Automotive, Food & Beverages, and Pharmaceuticals, Frederick currently holds a position at B|Braun Medical, Inc., the world’s 11th-largest medical device manufacturer, as a Project Controls Engineer as the principle MES Engineer.

Introduction

Looking back, from the first introduction of Computer Integrated Manufacturing and of Factory Information Systems, it is petty difficult to not notice the impact that Manufacturing Execution Systems have made on the world. Recently, there has been some questions concerning if there is a future for Manufacturing Execution Systems (MES) as Enterprise Resources Planning (ERP) solution providers enter the realm of the shop floor environment (Bond, 2008).

In my opinion, there is no question whether or not MES is here to stay. “The future of MES” is defiantly more and not less because of these five reasons rooted in basic economics:

- Current Economic & Market Conditions
- Globalization
- Demand for Manufacturing Intelligence
- Advancements in Medicine
- Stricter Governmental Regulations
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Furthermore, change through evolution; I believe is apart of life, even for the concept of MES. I believe the *The future changes of MES* will centering on but no limited to:

- The Reclassification of MES
- The Re-Marketing of MES

**The Future of MES**

**Economic & Market Conditions**

Years ago, while reading a publication concerning early American history, I came by a very famous quote which simply stated, *“These are the times that try men’s souls”* (Thomas, n.d.). Even though I was not among those within this generation who faced Britain’s taxation levy’s which made Thomas Paine’s statement applicable, there is no question about this statement being a truly provocative one or being a cadence that led this country into the America Revolution. Unfortunately, for some – Thomas Paine was indeed correct.

And if Mr. Gerald Celente, from the Trends Journal Research Institute, is also correct; I will be a member of the generation that witnessed what he is calling the, *“Greatest of Depressions”* (2010). In fact we are living in the same or if not, worse economic conditions that faced the Toyota Corporation, regarding capital, after Japan conceded the Second World War. During that time, the country in general and Toyota in specific had to answers some very tough questions. Essentially, for Toyota, it all came down to one simple question revolving around basic economics:

> **How does the Toyota Corporation function as a company despite the lack of capital and the availability of scarce resources?** (LEI, n.d.)

Taichii Ohno and his managers at Toyota were ultimately tasked with the idea of developing an innovative system that would guarantee the profitability for the Toyota Corporation given the current economic times (LEI, n.d.). In addition, the answers to Toyota’s fundamental question, on how it planned to survive, led to the development of a completely new science know as Lean Manufacturing. Many of the principles Ohno’s team engineered had its roots in best practices use at manufacturing plants ran by Henry H. Ford (LEI, n.d.). Even though, most methods were manual processes that employed technology as simple as a pencil and a piece of paper, it was their innovative principles reinforced by discipline that pushed the concept of *“zero defects”* (LEI, n.d.) which made the difference.

Tai-chii Ohno and many others who help author the Toyota Production System designed the system to withstand hard economic and competitive market conditions despite the lack of capital and availability of resources (LEI, n.d.). For it was the survival of the company that would subsequently ensure the survival of the country is what Taichii Ohno and the people at Toyota were truly engineering.

Taking the history of the Toyota Corporation and the state of the current US economy all into consideration, I can honestly conclude that that the future of MES is nothing short of being simply being brilliant. Conducting business in the *“Greatest of Depression”* (Celente, 2010) will force, what manufacturing that is left in America, to answer the same questions that Taichii Ohno had to negotiated decades ago. The only true saving grace, for manufacturing, theses days, is that technology like Manufacturing Execution Systems have advanced to levels where smart manufacturing organizations have many more viable, cost effective and proven methods to choose from than Taichii Ohno and his team of engineers ever did.

**Globalization**

As globalization becomes more of a reality everyday and the current economic conditions worsen, this will certainly influence more global collaboration and require each manufacturing business unit to perform at higher levels of
In Collaborative Manufacturing, designated individuals and organizations – both internal to a manufacturing enterprise and extended to its suppliers, customers, and partners – work together for mutual gain (Ashmore, 2004).

Manufacturing Intelligence is primarily software that is concerned with processing data it receives from multiple sources, including MES, in order to provide meaningful knowledge used drive the business.

MES is an on-line system of tools, functions and methods used within a manufacturing operation to achieve “Manufacturing Excellence”.

The primary differences are: MES provides manufacturing data required to generate Manufacturing Intelligence and MES is executed at the manufacturing level, while Manufacturing Intelligence is executed at the ERP level. Without MES collecting and sending production data to the ERP level, there would be no manufacturing data to produce any meaningful knowledge. To simply write both of these systems off as just software, especially MES, would be a major understatement.

Nevertheless, the data that the MES collects does hold a significant amount of value once the data has been processed and analyzed by a Manufacturing Intelligence system. And as Collaborative Manufacturing efforts increase, organizations tend to become much more efficient and will demand more Manufacturing Intelligence collected through innovative tools, like Manufacturing Execution Systems to run their organizations.

Advancements in Medicine
If you are one of the few people in the world without Internet connectivity, then I would not expect you to know that the future for the biomedical industry is now. The next generation of medical innovation will include personalized medicine, gene therapy, regenerative medicine and the possibility of growing of human organs through whole organ decellularization. By themselves, these efforts seem like something straight out of science fiction. The truth is, all of this is happening right now.

Eventually, figuring out how to mass produce and market these advancement in personalized biomedical products for the general public will be the next logical step. What this inevitably relates to, within the United States at least, are clinical trials, Food & Drug Administration (FDA) approval and periodic FDA inspections. Having the ability to mass produce human organs is one thing, proving to the FDA that a biomedical organization is in complete control of the manufacturing process is something entirely different. Especially when an organization plans use traditional documenting and testing methods; then the entire effort becomes seriously inconceivable.

The above becomes the center point of my argument, just documenting and testing alone by means of manual and paper methods certainly
ensures that errors will be made. This can’t happen when quality it fixed at 99.99%. To even think about undertaking a process like this means that the entire manufacturing process will consist of automatic in-line process controls for all critical parameters, monitoring from conception to transplant and a data collection systems recording the entire process. A specialized MES to handle this kind of manufacturing process is not even option; it is must in any of the endeavors mentioned above.

Stricter Governmental Regulations

In addition to the above, increased governmental regulations around the world are forcing Pharmaceuticals companies to adopt technology such as MES. Both ePedigree and Global Track & Trace of Pharmaceuticals products are soon to be not an option within the United States and in Europe. What this means to most Pharmaceuticals manufacturing company is that – anything sold on a unit basis will have to have a barcode that contains specific information about the product, the manufacturer which also includes a unique serial number on located on the product. With the amount of information that is to be encoded into a single barcode, manufactures were forces to transfer from an ANSI format over to a 2D barcode format. Considering the entire scope of work, that was the easy part. The challenging part of all of this is retrofitting the current manufacturing process to serialize and print this additional information on the product with unique serial numbers. If your manufacturing process shipped multiple units in a single case, then the each case must be marrying to any unit that it was packed into it. The case will also require barcode information to be printed on it as well.

Finally, at some point during the manufacturing process; the entire serialized product and their relationship to each cases and so on, will have to be uploaded or transferred to a regulatory global tracking & tracing database. The purpose of this regulatory global tracking & tracing database is to ensure patient safety by preventing counterfeiting. Distributors and wholesalers would then verify a product authenticity once the received a shipment by subscribing to the regulatory database. Once the 2D barcode is scanned, it can be at the case or either unit level for point of sale purchases, the product can be authenticated. All of this scanning and authenticating activity creates an ePedigree history, which the regulators are primarily interested in.

The first question that comes to my mind is how any of this can be achieved without the use of specialized software, automation and a shop floor infrastructure providing connectivity. And the answer to that question is that it cannot, or at least; not efficiently to stay in business long enough to generate a profit. This is exactly why there will be more demand for MES and type of functionally that it provides. All of this only adds credence for its need and continued use in the future of manufacturing.

The Future Changes of MES

The Reclassification of MES

The reclassification of MES was probably something that would eventually happen over time. Just as Computer Integrated Manufacturing and Factory Information Systems both dissolved into MES, the lifecycle for this concept will undergo its share changes in the near future as well. I believe it will be the demand for more Manufacturing Intelligence from increased Collaborative efforts that will be the driver. I see MES as being the core for MI – only because, the MES has access and connectivity to all the potential information that MI is interested in concerning the production process. Of course, MI will mix in ERP data and data from other sources, but without shop floor data, none of that would mean very much at all.

Once we consider a reclassification MES, somewhere, within that; I do see the MESA Organization possibly making changes to their current MES model. I believe the world will begin to see the big picture regarding how important MES is to the entire enterprise. The underling question to a remodeling of the current MES model would be, “What are the true core functions of a MES?” Answering that question gets us to a new model and would be consistent to how I believe MES will be package, market and sold in the future. Therefore, I can see MES with its core and full functions being reclassified under Manufacturing Intelligence.
And Manufacturing Intelligence will, in turn, solidify collaboration activities across the entire enterprise.

**The Re-Marketing of MES**

The biggest changes I see MES undergoing is how MES solution providers are racing to re-market and sell their products. Over the past few years, the MES market has witnessed a great deal of repositioning by software developers attempting to maintain or increase their current market shares. We have even seen ERP solution providers entering the MES market as well, which has cast some levels doubts on the sovereignty of MES altogether. This alarmed the market because ERP solution providers are positioned to offer customers a complete range of software solutions.

Even as ERP solution providers entering the MES market, I do not see these organizations raking in all the chips, at this point. I believe these organizations entered the MES market much too late. In addition, everyone in the market is not running an ERP solution. ERP solution providers are better positioned to provide a comprehensive Manufacturing Intelligence solution & interface versus a MES solution on its own.

Of course, the internal market for ERP solution providers is fair game, but even there; most of their customers may already have MES applications running their shops. New customers and existing customers without MES solutions become the real play, but existing customers running MES applications may only have the need for the Manufacturing Intelligence Solution & Interface that ERP solution providers can certainly provide.

Furthermore, much of this repositioning, mentioned above, has been done through mergers and acquisitions of companies with specific technology. The next step is to retool their product line. It seems as though all the MES solution providers are retooling their core MES products by shifting them to more commonly support source code languages such as J2EE and the very common .Net Framework. The idea is that this would give customers more environments to run their solutions on such as:

- Windows
- UNIX
- LINUX
- Virtual Environment

As the business world continues to be cost sensitive, virtualization will become extremely popular for a number of reasons. Purchasing fewer servers with expensive service agreement is one major factor for going virtual. Yet, it is the low maintenance, the quick change-over time and the ability to restore an exact replica of a mission critical system, in the event of catastrophic failure, which makes this option attractive. Despite having less budget to work with, customers will demand this and more functionality across the board.

MES solution providers are responding to by reorganize their product lines and offering more functionality, but delivering their solution as a Manufacturing Intelligence suite. The concept will have the updated MES solution, with its core functions, as the **MES Engine**. (Figure below)

Any additional functionality including the eleven full functions of MES and others functions such as:

- ERP / MI Quick Connect Interfaces
- Process Analytical Technology Tools
- Serialization for Global Track & Trace
- Visualization and Dashboard
- SCADA / OPC Sever
- Process Engineering Tools
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- Leaning Manufacturing Tools
- Database Spanning for 3rd Party Systems

THE POSSIBILITY OF A MODULES MARKET

Functionality like this will mostly likely be offered as “plug, configure & play” modules. Since, many manufacturing organization tend to implement one MES, the smart solution provider would begin to develop and market their modules as MES Engine independent. This means that their modules would work with just about any MES application on the market. If this idea takes off, there is a good possibility of a whole new “Module Market” being created. As idealistic as this may sound, I believe it is conceivable. What is not conceivable, is believing that a manufacturing organization would implement a new MES solution after it has already committed to one MES application years ago. This is why I say modules and or add-ons will become big money in the future as companies, who implemented a MES solution, have little or no options to change their core application.

New governmental regulations and market condition that will require additional MES functionality not part of the Core MES Engine. Therefore, the only real way to address these kinds of unforeseeable changes is through functional modularization. This will become a key selling point in the future.

COST SAVINGS THROUGH A PRE-VALIDATED VIRTUAL ENVIRONMENTS

Finally, any solution provider that can offer functionality and the flexibility of modularization puts a significant cost savings to a customer regarding validation will win more bids than those who can not. My point here is that, providing value to customers will be the center point of any sale discussion as we move forwards. Validation cost can easily range from 8% – 15% of the total project cost. When Solution providers start offering customers pre-validated software solutions where the customer can leverage the solution provider’s documentation, that’s when things get interesting. For those customers who are planning to run in virtualized environments, I believe this can become a reality. The solution provider creates an utopia environment which best suits its solution. The entire configuration and testing is done within that utopia environment. Once everything is completed, the solution provider then delivers the MES Engine with all the selected Modules and custom specifications along with a complete set of validation documentation to the customer. All the customer will essentially have to do is conduct or witness a Factory Acceptance Test and an audit of the solution provider’s validation methodology. If the customer is satisfied, they simple load the virtual environment on to a production server and only commission the software within their manufacturing infrastructure. Validation then occurs on everything but the software because it’s running in a virtual environment that has not and will not change.

Virtual Environments may become the ideal of the future because it may offer customers a significant amount of cost savings during the validation process, on top of its flexibility and other cost savings it provides

Making major system changes or adding functionality to your solution is done at the solutions provider’s office. And the process is repeated basically the same as before. The great part about this is, if the new solution does not work, you can always roll back to your old environment within moments. The idea is that the customer can see significant saving by moving to a commissioning practice. The dollars begin to add up even fast, if the software is installed on a system and a manufacturing infrastructure that has already been valid. In the days to come, functionality & flexibility is required, but value will truly be king.

Summary

Moreover, MES in its native form has without a doubt changed how the manufacturing world does business forever. From its earliest conception within the auto industry to its mainstream debut, it is safe to say that Manufacturing Execution Systems are here to stay. Globalization has change the landscape of
business altogether which further secured the future of MES. Globalization is the vehicle behind enterprise collaboration. And it is very difficult to have effective collaboration without good solid information about the business. These kinds of activities will certainly place pressure on the business to provide more Manufacturing Intelligence and not less.

Dismal economic and market conditions are also reasons that secure the future of MES. As times get harder, these market factors will force all levels of business to examine cost saving measures that not only measures that increase quality but those that promote profitability through manufacturing products that provide value to the customer. And it is with advancement seen in the Biomedical and the Pharmaceuticals industries where products developed from medical breakthroughs that will bring the kind of value never seen before.

In addition, nearly all of these types of personalized medicines and products of the future will have to guarantee extremely high levels of quality. Taking into consideration that governmental regulation are become stricter, manufacturing anything to that degree of accuracy cannot be accomplished through traditional methods. Without the aid of highly specialized manufacturing systems, production monitoring, data collection and data storing systems, it would very difficult if not impossible to prove complete control over this kind of manufacturing process to a governmental regulator.

Software developers have already begun to respond to these types of customer’s needs by retooling and reorganizing their MES solutions. These changes will reflect much more functionality that is modular and will be marketed as a Manufacturing Intelligence suite with an MES engine at the center.

Again, providing customers value or cost savings is a universal concept in these times. This covers everyone, even software developers. Solution providers, who can deliver a pre-validated solution that runs in a virtual environment to its customers doing business in regulated industries, may see increased market share and huge win-falls. And at the end of the day, that is what this is all about.

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