Manufacturing Steps Onto the Enterprise IT Stage

Ask almost anyone working in a manufacturing enterprise what ERP system they use and you normally get an instant, single answer. The worst you will hear is that they are using one vendor now and are moving to another soon, but that is about the extent of ambiguity across an enterprise when it comes to what major business system they rely on. Ask most OEMs the R&D software they use, and you will quickly hear one of the big three PLM software names, no matter who in the enterprise you ask.

Now consider asking the following question, “What software system do you use for manufacturing?” Normally there is a pause to collect one’s thoughts followed by, ‘It depends on which site,” or often, “We use A for line control, B for optimization, C from our machine vendor for traceability, D for process planning and launch, X for paperless documentation, Y for test, and something IT built for quality information and reporting.” Or, from those who have accepted the issue as the problem it truly is, “We don’t use one system for manufacturing.”

The concept of a single, comprehensive information solution collapses when one enters the manufacturing, quality, and process engineering offices, and certainly on the factory floor. Software product proliferation is rampant in electronics factories. Fortunately, as business leaders in manufacturing enterprises look for better ‘time-to-value’, quality, and visibility to the operations that actually produce their value, a new focus is on manufacturing information technology. This focus has led to a new category of “enterprise level” software called Manufacturing Operations System (MOS) Software. The advent of MOS represents both a significant technical and business transition for manufacturers who intend to remain competitive in the global market.
Necessity Drives the Emergence of MOS

To explore the purpose and value of a MOS system is to consider first how it naturally emerged as result of the market needs and conditions.

The value of consolidating software solutions was appreciated long ago on the business side of the manufacturing enterprise. This drove the scope of ERP solutions to service virtually every aspect of business and financial management operations. Massive investments in such systems were made in the last decade by business leaders in all forms of manufacturing enterprises. Today, these companies would likely shudder at the thought of not having a single integrated solution for their business operations.

The next evolution involved R&D. Once the financial and business operations were running more efficiently as result of ERP investments, business leaders turned their attention to ‘time-to-market’. Taking a product concept to a finished design affected competitiveness. Product Lifecycle Management or PLM systems brought design, collaboration, version control, and simulation systems under one massive software system. Billions of dollars were invested in these systems as well.

Then came the final problem. Manufacturing enterprises, having invested hundreds of millions of dollars in ERP and PLM solutions, began to consider why they continued to have key business issues despite these investments. The business offices ran well. Financial reporting, customer management, accounting, sourcing, even HR all were improved. R&D was turning out better designs faster and under better control. Information access was greatly improved. But despite all of this, the enterprise was still too slow in ramping up to a quality, full speed production run. Changing designs mid-production or even between products or jobs was too slow. And once the products were shipped, traceability and quality metrics were cumbersome and slow to obtain. In summary, their ‘time to market’ was fast due to their PLM and ERP investments, but they realized that in order to ship product the factory had to ramp up and run efficiently. They had a problem with ‘Time to Value’ -- they had to shorten the time required to get a quality product shipped to a customer so it can be turned into revenue. This finally turned management’s attention to factory operations.

The problem was rooted in disparate software tool proliferation. This occurred because rather than addressing factory information in a holistic manner as PLM and ERP addresses R&D and business, operations investment in software had been reactionary. For each requirement placed on the factory, a new software system was spawned. When traceability was demanded, a line-level software tool was
purchased. When process planning and launch was too slow, a CAM tool was purchased. The test department logged its data in a system they purchased while the quality department ran a data collection tool of their own design. There are many variants of this story, but the theme is always the same. In many cases, manufacturing information systems do not operate on one data source, and there is no means to monitor, view, or mine the information across all of them.

As reaction, IT departments or integrators have tried to ‘knit’ these systems together. This has led to significant staff overhead dedicated to designing reports and other tools intended to bring this disparate data together. Some enterprises are crushed under the costs of this internal IT engineering, or that of third party integrators in an effort to harvest data they need from the factory.

**Enter the Single Solution**

There is now a desire to have what might be called the ‘Third IT Pillar’ in the enterprise – the software system devoted to manufacturing. This concept has come to be called MOS. Its goal is to exist as a complementary system to ERP and PLM and to consolidate the systems and visibility to everything that goes on within the factory office and factory floor.

Consider first the financial benefits of consolidation of these disparate manufacturing systems. When a single system covers manufacturing operations and by nature provides seamless reporting, monitoring, and analytical data, the enterprise only needs to build an integrating bridge between PLM and ERP and this system. Rather than hundreds of integrations and databases, the task of integrating only two major systems is manageable, and consequently much less expensive to build and maintain. Exploring further into cost savings, the enterprise need only form a relationship and invest in maintenance with one vendor rather than many vendors. In terms of data fulfillment, the legions of report writers and IT personnel typically employed to develop data for engineering, regulatory agencies, customers, or executives can turn their attention to more useful tasks, as the information is now available through one system.

The operational benefits of MOS are vast. When one considers manufacturing software in the context of ‘lean’ there is simply no more efficient way to handle information than through one system and one data source. MOS spans so many functions in the operation that its very operation is by nature faster and easier. There is no file passing or transfers, or data migration from one tool to another. There is no need to join data together to achieve one view of information. Everything flows from the design department, through a process planning engine, out to the floor to control materials and production movement,
acquires real-time data from the machines and test systems, and then presents the byproduct of all these processes in real time or analytically. Plan, execute, and analyze all through one solution and one data source connected to virtually every activity operations-wide – a software concept that mirrors the essence of lean.

The MOS Empowered Enterprise

Electronics assembly presents unique challenges when compared to processes such as ‘box build’ or system integration. Planning, documentation, machine programming, shop floor materials control, and even bill of materials management require more depth in electronics than seen in more generalized steps across a box build process. MOS in electronics begins with a rich awareness of the corporate part master, inventory master, customer part numbering relationships, bill of materials versioning, and design versioning. The baseline information sources that descend from business and R&D systems must be reflected in the core data model and systems of the MOS solution in order to even begin its operation.

The first phase of operation involves planning. When the CAD design data and BOM for a particular work order are applied to process awareness that spans an entire factory (or multiple factories) the MOS system assists process engineering in creating a total plan for the manufacture of that product. This planning phase of MOS includes the design of the route flow, the component and activity allocation across the route, the ‘bill of process’ for each step against which materials will be verified on the shop floor, operator visuals, machine optimization and programs, quality and test operations, and supporting reference materials to be presented to operators when required. This becomes the assisted development of what is essentially a ‘digital work package’ to provide the factory every conceivable guidance, verification, and information they need to conduct a quality build efficiently.

Execution on the shop floor is controlled and monitored. MOS enables control of both axes of production; the product flow through the route, and the components, consumables, and tooling that must intercept that flow at the exactly right time and location. Components, feeders, carts, tooling, and chemicals are all tracked and verified ensuring a correct build. The flow sequence and activities along the route are also enforced, but the system also dispatches interactive operator visuals to each station automatically, providing a fully paperless environment. MOS drives quality data collection, repair automation, and diagnostics by providing operators the visuals and context data they need to manage in-process quality efficiently.
**A data-rich environment is the key.** Underpinning the visible activities of the process is the equally important element of MOS which comprises the real-time data acquisition from machines, test, and other data sources. The data base upon which the solution rests, however, needs more than the product and materials movement information. It requires the real time data from assembly, process, test, monitoring, and inspection systems. Most important, the solution must provide a native ability to conduct materials verification, WIP tracking, etc. but must also be able to leverage existing machine systems sometimes provided from the vendors, such as feeder setup solutions. Rather than replacing such tools, MOS can add value by folding their functions into the overall solution as a data source, thus leveraging rather than disposing of prior investments -- but yielding the same functional and informational result via MOS.

**Analysis, reporting, monitoring and traceability** should be the natural byproducts of a solution involved in the aforementioned functions. MOS approaches the issue from the perspective that a totally controlled and monitored process will naturally yield any type of traceability desired. To make such a system valuable, it needs to empower its users to view, analyze, and report any data they require without having to consult their software vendor or IT department. The information should also be available via real-time dashboards or through data extraction and reporting systems that do not expect the user to know anything about databases, SQL, etc.

**The full business value** of such a holistic system is realized when the factory is running real-time dashboards and engineers and production planners are analyzing their quality and production information completely on their own. In the best deployments, plasmas above factory lines display rich actionable data dashboards, providing operators graphical notice of conditions in time for them to react. Engineers and managers are mining the database using graphical tools to visualize vast amount of data easily, and then generate reports when desired—without IT intervention. And, of course, operators in the factory are given the information and guidance they need to do the best possible job.

**Conclusion**

The consolidation of disparate software and information systems in the factory is becoming a necessity. Consider how traceability, reporting, and analysis demands are increasing while the need to reduce costs to compete is increasing at an equal rate. These two demands appear to run counter to one another; historically, this has been true because of the inefficient way manufacturing information is managed. With the advent of comprehensive, operations-focused MOS software systems, the personnel and IT overhead required to achieve world-class process speed, control, and visibility is greatly reduced.
A single, powerful system encompassing all the processes within manufacturing operations is long overdue. The evolution of systemic software thinking from the business side, to R&D, and now into the plant is logical. Now, the last functional area of a manufacturing enterprise to be given access to a singular information system is the very area of the enterprise that creates the value; manufacturing. It should be gratifying to operations professionals, from line operators to engineers to plant management, that their requirements are finally gaining the benefits of enterprise level software that is taking its place alongside ERP and PLM. With the growing deployment of MOS software, the answer to “What manufacturing information system do you use?” is becoming much simpler.