Building
Tomorrow's Enterprise

View Point

Integrating MES and Enterprise Systems

Creating the agile and responsive high-tech manufacturer

Sandeep Kumar

Fulfilling the manufacturer's mandate

Imagine you're the CIO of a leading manufacturer in the optical networking space, producing parts and components for the telecom industry. Your executive team has an enlightened view of the tremendous potential for Information Systems to be a strategic enabler, turning e-business process automation into a competitive advantage. So you set some stretch goals in your "IT Applications Plan":

- Near-immediate production responsiveness to market imperatives
- Production-line scalability to handle dramatic changes in production volumes
- Best-in-sector time-to-market benchmarks for launching innovative new products

You have no doubt that these objectives can be met. And the benefits could range far beyond mere production-line efficiencies. If you could generate real-time data, for instance, it would be more accurate, providing more effective decision support on all production and supply chain issues – which would have a positive influence on improving customer service and decreasing cycle times.

Jan 2005

Making the case for the agile manufacturer

The goals of our optical networking CIO are more than wish-list, blue-sky objectives. They are necessary responses to the hard realities of the 21st century high-tech marketplace. The factory operations of today's high-tech manufacturers must be driven by global planning and tight order management. When you need to manage advanced material allocation, early order promise with ATP (available to promise) and demand-supply alignment between supply-chain partners, it is essential to have tight system integration across enterprise and factory-level systems.

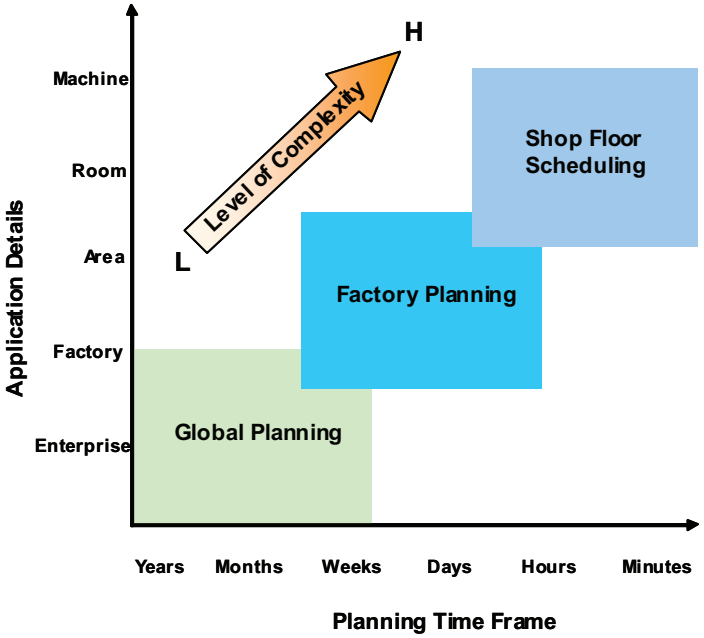

Figure 1: The planning sequence for a high-tech manufacturer

As you can see in Figure 1, there is a multi-tiered planning sequence underlying manufacturer operations. While global planning and factory planning are typically long- to mid-range operations done by enterprise systems in a proactive manner, shop floor scheduling is reactive and dynamic and is typically done by MES systems on a daily basis. Covering such functions as job sequencing, work-order routing and equipment scheduling, shop floor scheduling is highly dependent on real-time information on capacities, priorities, material availabilities, and manpower positions if it is to be optimally cost-efficient and productive.

And it is imperative that shop floor scheduling be optimally cost-efficient and productive. To be competitive today, the high-tech manufacturer must accomplish four, sometimes conflicting demands:

- Optimize On-time delivery – Particularly in a hyper-competitive category, this might more properly be entitled "optimize ahead-of-time delivery." Cycle times are continually being shortened. Workflow must be managed and optimized to move order-to-delivery cycle time ahead of the competition. To do that, your MES applications must be integrated with enterprise applications that can provide "What if…?" analysis.
- Minimize costs to Maximize profitability – Increasing market share isn't enough anymore. You must increase profitability…continually. This requires a tight coupling of corporate planning, factory planning and line dispatching applications. When the production line is integrated with your market forecasting and business analytics applications, you can minimize obsolescence costs in the face of product proliferation. By implementing comprehensive just-in-time production measures, you can reduce inventory-holding, transportation and handling costs.
- Optimize equipment utilization – With MES working hand-in-hand with enterprise planning applications, equipment can be scheduled to optimize overall equipment effectiveness (OEE) as well as increase productivity from installed equipment. With realtime information supporting more accurate planning, both equipment maintenance scheduling and higher throughput can be realized more efficiently. So you can be more productive at the same time that you reduce wear-and-tear on equipment.

- Customer satisfaction – When products are delivered on time, customers are happy. With extensive monitoring and controls through the production sequence, higher quality can be attained, which reduces the time and financial costs of reworking – and makes customers happy. Whenever system integration optimizes your operations for greater efficiency and productivity, you're more likely to make your customers happy.

There is a vast universe of benefits from tight MES/Enterprise integration. For example:

- Order Change Controls provide the flexibility to continually adjust orders right up to the time that they are put into the production cycle.
- Proactive Production Planning provides advance notice for when in-house capacity is maxed out and contract vendors need to be used.
- Advanced Production Systems offers the capability to do late-order assignment.
- Assembly Line Stability sequences jobs to optimize operations by reducing production-cycle variability.

Entire business models, such as build-to-order/assemble-to-order, are enabled by such comprehensive cross-application integration. Vast supply chains can be more efficiently managed. For instance, consider just this one smaller-scale example from our optical networking manufacturer. With razor-thin tolerances, parts must be engineered to extraordinarily tight specifications, which makes the manufacturer's operation entirely dependent on the meticulousness of its suppliers' operations. With the right integration of MES and enterprise applications, the manufacturer can link vendor payments to its assembly and testing operations. If a vendor's work falls short, the Accounts Payable application can withhold payment for the faulty components rather than putting the manufacturer in the position of having to recover its funds.

There are so many and such varied, benefits from MES/Enterprise integration that it is no longer a question of whether to do it. The critical issue is *how* to do it.

The complexities of MES/Enterprise System integration

First, let's look at the application landscape that today's typical high-tech manufacturer is working with.

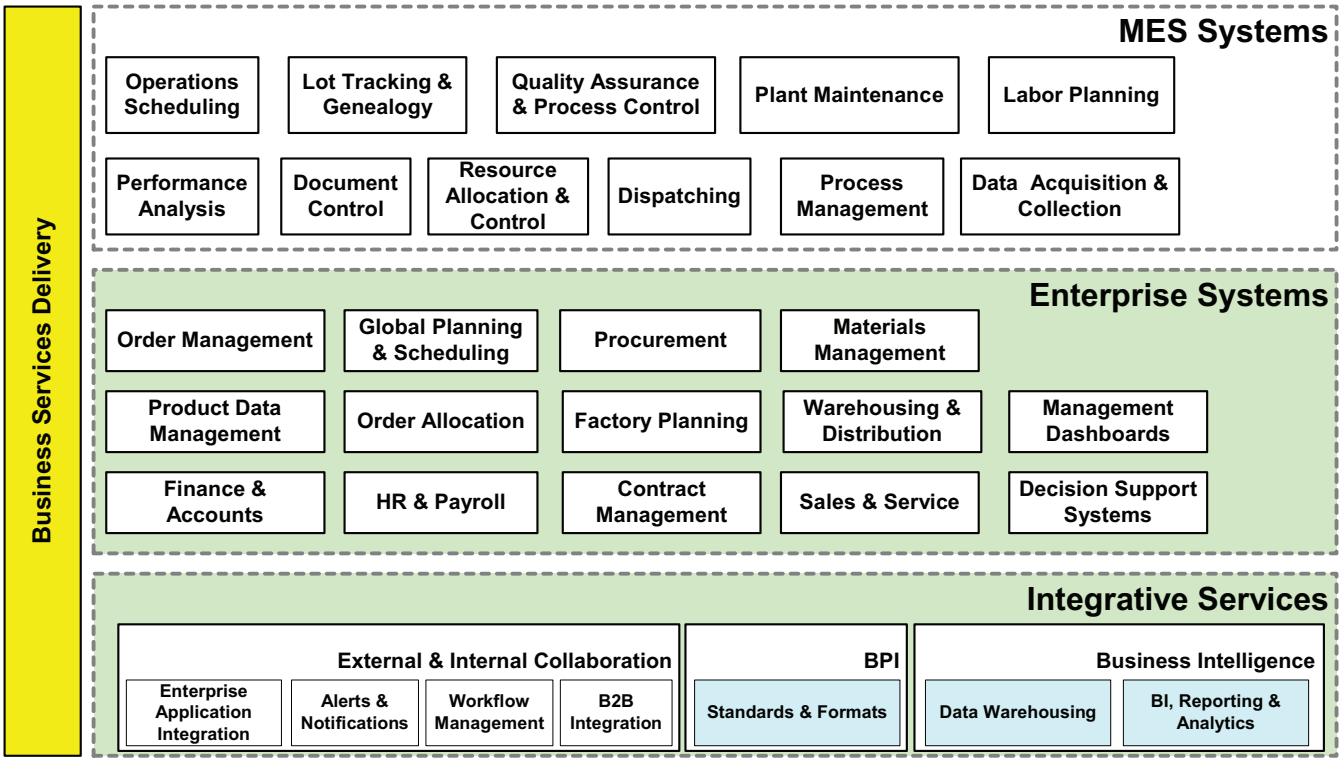

Figure 2: MES and Enterprise applications: A logical architecture

In Figure 2, you can see the seeds of the four great complexities facing the high-tech manufacturer who is intent on integrating MES and Enterprise systems:

1. Sheer quantity of applications – And this chart doesn't give you anything close to the full picture. Take the Quality Assurance & Process Control box, for instance. In most manufacturing settings, quality actually has a separate application for each function. So there is a quality application for manufacturing, for service, for parts, even for individual plants with a company's global production network – each application and its data tucked away in its own silo. Then there is Process Control, which is actually an entire family of applications that does the actual tracking and monitoring of various process and equipment parameters.
2. Disparate nature of the applications – As you'll recall from Figure 1, the MES and Enterprise applications operate with very different ranges of timing and granularity. Even when the Enterprise application is working on data for an individual facility, it will be working at the building level and in time-units of days or weeks or months. The MES applications, on the other hand, will involve data for individual machines and does time calculations using hours and even fractions of hours. These different frames of reference further complicate the integration of the two groups of applications.
3. Vendor diversity – Figure 2 shows 11 functional areas. Each functional area has more than one and sometimes several applications. And there are different vendors specializing in individual functional areas. In fact, there are even specialty specialists, as some vendors narrow their solutions to specific vertical industries – this reflects the fact that MES systems have traditionally evolved as niche solutions for specific industry verticals.
4. Integration driven by the vendors – Vendors are always looking to add value. With such a diverse mass of applications, an obvious area for adding value is in application integration. But that has meant that bottom-up, "point" integration solutions are going on in several different areas and from several different directions:
    a. Downward integration – ERP application vendors are expanding functionality to begin incorporating MES functions
    b. Upward integration – Plant-automation vendors are developing additional functionality in order to provide ERP functions
    c. Industry focus – Industry-specific MES vendors are cobbling together all the pieces to offer a fully integrated MES solution that provides complete functionality…for a specific industry
    d. Functional specialization – MES vendors are staying focused on a particular function, but then developing a best-of-breed solution to maximize productivity for that particular function.

These complexities capture the dilemma facing high-tech manufacturers:

- The integration is being driven by the vendors rather than the customer
- Most of the integration efforts are struggling just to get all the MES applications coordinated. Only the ERP vendors are attempting to move into MES and their efforts have been unimpressive to this point: there are just too many MES applications to readily incorporate them into a seamless whole, especially when you are not used to playing in the MES space in the first place.
- Even the most inclusive integration efforts to date come across largely as point solutions. There needs to be a holistic approach to integration if the full promise is to be realized – yet coming to grips with all the many applications in Figure 2 is an incredibly daunting task.

This is why Infosys believes any MES/Enterprise integration effort needs to begin from a top-down perspective, and must use processes as the organizational foundation for a staged implementation of the integration to make it both manageable and effective.

The Infosys approach: A roadmap to full integration

Given the number and diversity of systems involved, any MES integration with enterprise systems has to take a systems-integration approach that may also involve the integration of multiple platforms. Infosys believes such a complex integration challenge requires a process-centric approach that will assist in aligning the MES and enterprise resource planning (ERP) platforms to the business process needs. Such an approach must necessarily begin with a rigorous assessment of the strategic business objectives and how business processes align with the objectives. To be successful, MES/Enterprise system integration requires a clear understanding of the information flow across the enterprise and shop floor operations for any given process.

For instance, our optical networking manufacturer may want to concentrate on optimizing on-time delivery. On the MES side, that would involve work order generation, manufacturing process management, work-in-progress (WIP) and lot tracking, and dispatching applications. Among enterprise applications, the delivery function would involve processes such as order capture, order allocation and management, and perhaps the CRM application.

Clearly, this would be a complex undertaking involving large-scale system integration.

Infosys brings a basic four-step system to planning and implementation of such massive and complex integration projects:

- Business assessment
- Business case development
- Implementation planning
- Execution

Business assessment

This is where the process-centric approach is so valuable to optimizing the efficiency and effectiveness of an MES/Enterprise integration initiative. Bringing a process-centric perspective to the business assessment is likely to reveal sometimes obscure variations in processes that might exist across business divisions, facilities and geographic regions. For instance, our optical networking company might have multiple facilities, largely acquired during expansions and mergers, each running on a different set of MES applications executing the same function.

The goal of this opening assessment is to create a strategic alignment between the MES and Enterprise system applications. What are all the ways in which the manufacturing operations rely on the supply chain, for instance? How can manufacturing better interact with your CRM program to operationalize a build-to-order model? How can your ERP investments best be leveraged by your manufacturing operations for greater efficiencies?

The discovery process involved in answering these types of questions not only establishes the areas of greatest potential benefit from the integration, it may also help identify areas for improvement on both the manufacturing and the strategic planning side. This approach allows you to rationalize and standardize processes all across the enterprise. For that matter, if the same rigor is brought to assessing the application architecture, a business case might then be made to seek further efficiencies through application rationalization.

Business case development

Once you have established where the opportunities for improvement exist, you are then in a position to set priorities and make a business case for implementing a staged integration. This prioritization will be different for every company. As an example, our optical networking company might have a strong service reputation and have built its brand around a customer-first image. It might therefore have on-time delivery as its highest priority. If you are sitting on aging production-line equipment at your most frontline facilities, perhaps optimizing equipment use for reduced stress is your primary concern.

You will also want to consider which process improvement provides you the best opportunity for creating the most significant competitive advantage in your industry sector. Your assessment of pre-existing vendor-initiated integration may also require consideration: if one of these fledgling efforts provides the groundwork for quicker, less capital-intensive implementation, then that may be your best move for reducing costs while maximizing profitability. Hence, there would be a pressing need to develop a roadmap that clearly provides for a staged integration based on business value and customer need.

It is important to recognize that there are advantages on both the planning and operational side, but that the business case is based on where the greatest strategic benefits lie – for your company, in your competitive marketplace. Applying preconceived notions to the benefits analysis and business case development can undermine your efforts.

Implementation planning

The challenge here is in establishing the nature of the interface. In an ideal world, data would only be entered once, but could be used by many different employees, working with several different applications. The successful integration initiative manages to reconcile the data with the variety of functions for which they are to be used, and to create interface points that closely align with the way work was being done prior to the integration.

The level of complexity to MES/Enterprise system integration raises entirely new classes of implementation issues. If a transaction fails, for whatever reason, is the appearance and implications of that failure the same for the Order Management application on the Enterprise side as it is for the Dispatching application on the MES side? There are dozens of questions like this that must be assessed at every point of integration.

Even though interface design is meant to follow pre-existing operating mechanisms and to be minimally disruptive, significant consideration still needs to be given to issues of employee training and cultural transformation. An integration initiative that fails to get full buy-in from the manufacturing facility and its people (from management down to the most basic technician) is a failed initiative – and full buy-in requires a clear explanation of exactly how the integration will alter "the way we've always done it" – from the simplest data entry to the real-time monitoring of orders-in-process – and a relatively painless training process to bring everyone up to speed.

Execution

The seeds of a successful execution are planted during the initial "assessment" phase of the integration process: identifying pilot sites which offer the greatest opportunities for success, with the least effort, and provide the highest returns on investment. This is necessary not only to promote adoption and use of the newly integrated systems, but also to most effectively justify the integration to executive management.

There are several factors that contribute to an optimum pilot site, including:

- Top-down support from management
- Significant opportunities for operational improvement
- Dedicated team overseeing and rolling out pilot
- Definitive metrics for establishing the success of the project

To ensure continued success, however, a successful pilot must be followed up with a thorough assessment of distinctive characteristics of the site and how those factors may have contributed to the success (and alternatively, how the lack of one or more of those factors could reduce the chance of success at other sites as the roll-out broadens). Alternative execution strategies may need to be developed to accommodate any dramatic differences in subsequent sites.

In the final analysis

While system integration tends to be a complex, time-intensive undertaking, Infosys believes that a staged, process-driven approach to MES/Enterprise system integration offers an opportunity for high-tech manufacturers to begin reaping benefits from the integration more quickly and cost-efficiently.

As this incremental integration enhances the flow of data and communications between more areas of the shop floor and the corporate offices, the benefits that will spread to more processes and functions include:

- More reliable data for planning and decision support, particularly in time-sensitive situations.
- Reduced costs and wastage from missteps in shop floor scheduling.
- More streamlined and efficient order handling for more dependably on-time delivery.
- Enhanced management of supply-chain activities for greater cost-savings

To significantly improve your odds for success, Infosys believes you need to find the right mix of technology, process change, and consulting savvy. Only by doing so, can you implement solutions with the high level of predictability needed to deliver the full operating-efficiency and financial advantages of MES/Enterprise system integration.

Author Profile:

Sandeep Kumar
Sandeep leads the manufacturing and supply chain group within the Domain Competency Group at Infosys. Sandeep has more than 10 years of industry and consulting experience and has worked with clients spanning a host of discrete manufacturing and retail industries. Sandeep's areas of interests include evolving supply chains in the high tech manufacturing industry and collaboration in supply chains. Sandeep can be reached at Sandeep_kumar@infosys.com

Infosys Hi-Tech and Discrete Manufacturing (HTDM) Practice

The Infosys HTDM Practice delivers business solutions to Fortune 500 clients representing all parts of the Hi-tech and manufacturing value chain, spanning from semi-conductor manufacturers to OEMs, value-added resellers and distributors, software products and service companies and other discrete manufacturing companies. Infosys provides services that cover business process conceptualization, process engineering, package selection and implementation, application development, maintenance and support, infrastructure management, product engineering and business process outsourcing. To meet customer needs, Infosys leverages strategic alliances with our partners including IBM, Informatica, MatrixOne, Microsoft, Oracle, Sun Microsystems, TIBCO and Yantra.

Infosys® | Building Tomorrow's Enterprise

For more information, contact askus@infosys.com

About Infosys

Many of the world's most successful organizations rely on Infosys to deliver measurable business value. Infosys provides business consulting, technology, engineering and outsourcing services to help clients in over 30 countries build tomorrow's enterprise.

For more information about Infosys (NASDAQ:INFY), visit www.infosys.com.

© 2011 Infosys Limited, Bangalore, India. Infosys believes the information in this publication is accurate as of its publication date; suchinformation is subject to change without notice. Infosys acknowledges the proprietary rights of the trademarks and product names of other companies mentioned in this document.