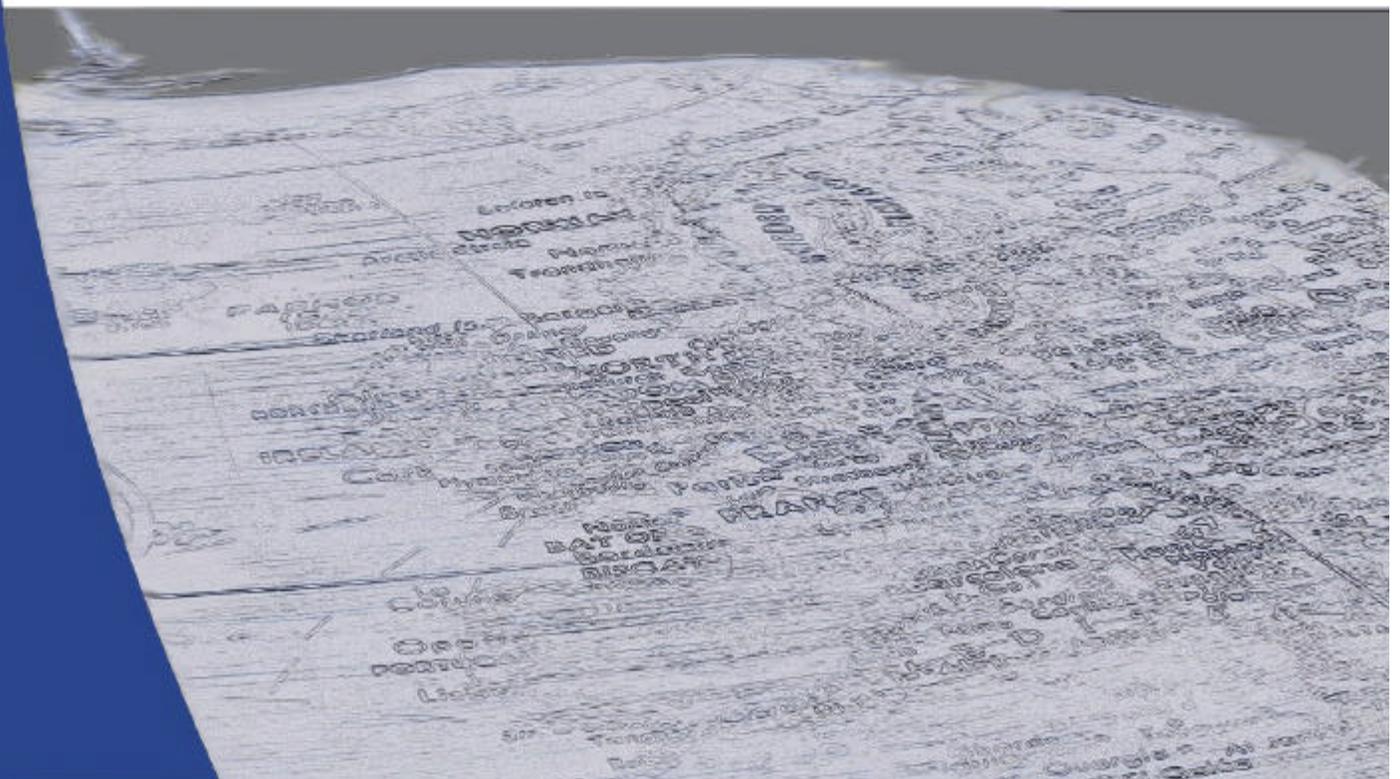*Unifi Technology Group*
& Software Toolbox, Inc.

Executive Summary

Building the Infrastructure for eManufacturing

Building the Infrastructure for eManufacturing

The term eManufacturing has emerged over the last 12 months. The purpose of this paper is to take a closer look into the meaning of the term and examine the necessary building blocks. It should be noted that eManufacturing is not enabled by any single software package, but rather by building an infrastructure with visibility into all manufacturing sites that allows seamless data flow throughout the enterprise and the extended supply chain. This will require disparate data from different software packages to be brought together with a real-time view for better decision-making and Supply Chain collaboration.

Definition of eManufacturing

"*A responsive manufacturing model that optimizes the use of production assets based on information exchange from shop floor operations, across the enterprise and the extended supply chain.*"

Simply defined, but not necessarily easily obtained. As we examine the information flow within a typical company, the problem begins within the manufacturing plants. The production floor is not tied into the enterprise. Thus, an information gap exists between the factory floor and the corporate systems that govern business and supply chains. Processes cannot be optimized, nor can accurate information be disseminated, without this real-time data information flow.

Forrester recently published data from a survey of the top 50 global manufacturing executives asking them to define their biggest problem – the number one answer was "poor visibility into the shop floor." (38%)
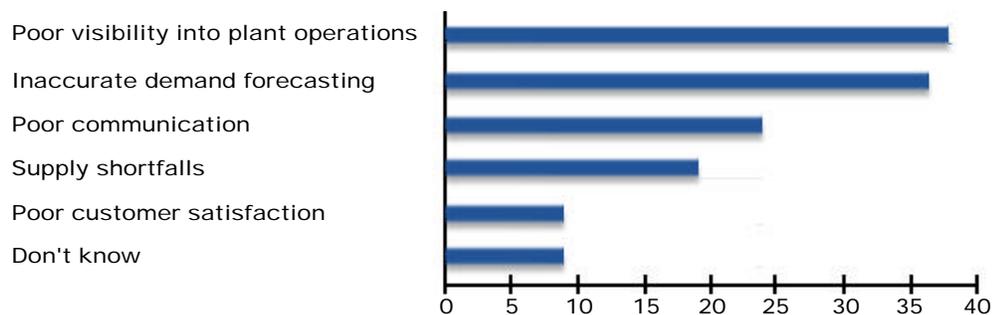

The problem is compounded because data exists in different systems within the manufacturing site – production scheduling, quality systems (offline and online), SCADA systems for machine and operator control, maintenance and warehouse / inventory management. Each manufacturing site needs the data to be consolidated into a single repository for real-time data

and historical data. In addition, a common platform should exist for viewing and reporting information throughout the site, and throughout the enterprise. This can be accomplished by using "thin client" technology for the presentation layer.

Examining the Building Blocks

The good news is various software packages have emerged to address these issues, thereby reducing the amount of custom code required to build the necessary infrastructure for eManufacturing (figure 1). One of the core building blocks is Manufacturing Execution Software (MES). The MES system gives the business system visibility into the shop floor. All WIP inventory is tracked along with raw material consumption. Interface to automation technology such as ID tracking and material-handling systems ensures accurate product tracking and proper routing of all sub-components.

eManufacturing Infrastructure
Figure 1
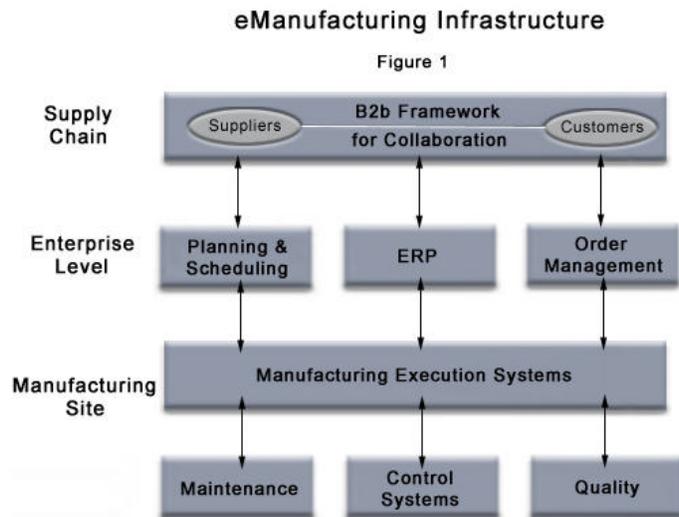
MES also enables scheduling to be done based upon available production resources and model workflows. Interfaces to the SCADA layer allow for automatic dispatch of work orders and machine setup. In addition, all process variables can be captured and analyzed, provided there is a direct interface to the plant floor.

The MES system provides the framework for bringing together other data sources within the plant environment such as preventive maintenance and lab information management systems (LIMS). Information is held within the local plant database for real-time decision-making and historical analysis. Additionally, OLAP tools may be used in conjunction with this database in order to refine the process. This also allows for the automatic dispatch of operators or maintenance personnel based on alarms or unplanned events.

The MES system connects to the shop floor control, maintenance, quality, and lab data sources using off-the-shelf software components such as OPC Clients, OPC Servers, and

ActiveX controls. These technologies reduce the total cost of integration and provide investment protection. By using off-the-shelf technologies, companies building eManufacturing Systems are able to leverage technology investments made by providers who specialize in this type of connectivity. The technologies are designed to cleanly plug into existing MES level software integration technologies. In some cases these software connectivity components provide added value to the MES system by with optional data visualization tools that cleanly plug into existing MES systems. Companies with core competencies focused on the details of digital communication with shop floor devices and control systems typically provide these software tools.

With this framework in place, critical information can easily be linked back to corporate business systems enabling a real-time view of plant operations. Updates can be based on a set time interval. To maximize the value of this real-time information exchange, system interfaces need to be established with corporate planning and order management systems. The interface may be with a standard ERP package through open interface tables or may utilize

Road Map for building the *eManufacturing* infrastructure

Manufacturing Site

- Establish real-time and historical databases at each manufacturing site, where MES system can bring together information from other systems - Quality, Scheduling, Alarming, Manpower tracking, SCADA and Maintenance

- Utilize middleware technology to ease interface to legacy and bring together all disparate data

- Use off-the-shelf technologies such as OPC and ActiveX to connect MES systems to the shop floor.

- Use thin client technology where possible to provide web-based reporting and viewing - (Intranet for manufacturing information)

- Add auto data collection layer, if necessary, to capture real-time status of production equipment and process variables

- Deploy Product ID technology for tracking product from materials through finished goods

- Loosely couple manufacturing sites to corporate ERP system through distributed database model

- Link MES to demand planning and advanced scheduling.

Enterprise Level / Supply Chain

- Let specific customer demand data drive scheduling (try to get view of your customer's customer) - use the internet and appropriate collaboration tools

- Internal disparate databases and legacy systems must be brought together to support better decision making across the enterprise - use middleware software where appropriate

- Move order management to the web, support a single "face" to the customer

- Extend ERP system to support B2B transactions and real-time queries - utilize software which offers EAI functionality and supports collaborative workflows

- Add supplier portal to share real-time quality data and raw inventory consumption

- Use PDM software to collaborate with key suppliers on new product introductions

middleware software for connecting with legacy systems.

The real-time connection into manufacturing gives the enterprise a more accurate view of ATP (available-to-promise) and CTP (capable-to-promise) information. This becomes essential in supporting an ebusiness strategy, as a company must have a real-time view of its ability to fulfill customer orders.

Further optimization occurs as the Internet is used to communicate to customers and suppliers. Better decisions can be made that reduce inventory levels, produce better schedules and introduce new products quicker. For true eManufacturing, the enterprise needs to be extended to support this collaborative environment.

Building the Infrastructure for Collaboration

To support this information flow, an active data warehouse needs to be set up to consolidate information from different data sets. Sources of information typically include ERP, warehouse management, advanced planning and scheduling and MES.

Next, a framework for sharing information needs to be established (numerous choices exist). A simple application would be to build an Extranet by adding a supplier portal where quality information and raw inventory consumption would be shared based on real-time updates. A more complex application would require a framework where collaborative workflows could be defined. An example would be working with suppliers on introducing a new product or setting up automatic material replenishment. The framework would also need to support agreed upon data schemas to facilitate B2B transactions. (Note – this will become easier with the acceptance of XML standards like UDDI.)

Going forward, planning/scheduling and order management functions that have been typically performed within the enterprise are moving to the web (figure 2). Ordering online and customer self-service modules are simply much more efficient.

eManufacturing Infrastructure

Figure 2
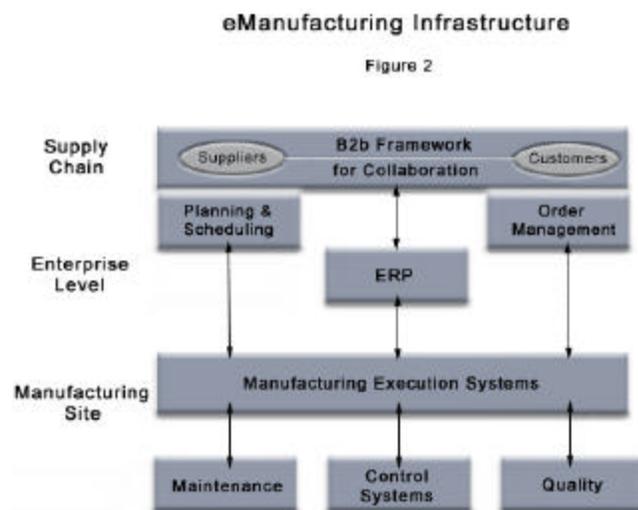
Forecasting demand becomes easier with visibility throughout the entire supply chain.

Furthermore, with a connection into manufacturing, accurate delivery dates can be given as customers query the enterprise for availability. Also, the infrastructure can support online product configuration and build-to-order manufacturing.

Financial Benefit of eManufacturing

With an eManufacturing infrastructure in place, better decisions are made based on real-time information, leading to a competitive advantage as processes become optimized. Financial benefits are realized at both the plant level and throughout the enterprise.

Typical benefits are:

- Inventory Reduction   25%-60%
- Cycle Time Reduction   30%-45%
- Delivery Performance   16%-28%
- Forecast Accuracy   25%-80%
- WIP Reduction   17%-55%
- Data Entry Time Reduction   50%-75%
- Paperwork Reduction   35%-55%
- Defect Reduction   15%-35%
- New Product Introduction Time   30%-65%

The key to success is to focus on the performance metrics that will have the greatest impact to the business. This will drive the selection of the necessary building blocks (functional software layers) and determine priorities for building an eManufacturing infrastructure.
Beyond the operational metrics, a more significant impact can be seen at the strategic level as well. With the investments described in this paper, an enterprise will find itself well prepared to take part in all aspects of e-Commerce today. In addition, the eManufacturing enterprise will find itself capable of producing a better mix of high margin product, with improved fulfillment performance and improved customer satisfaction. Finally, all of these benefits will translate to considerable improvements in bottom line profitability and return on assets.

Unifi Technology Group
Company Overview

Unifi Technology Group, Inc. is an e-manufacturing solutions provider that assists companies in optimizing the use of their production assets. By architecting and implementing strategies that leverage existing software infrastructures, they provide their customers with the ability to integrate supply chains over the Internet while enhancing operational manufacturing efficiencies. This involves the creation of data models for process workflow that are then used as the foundation upon which to build solutions coupling enterprise systems with plant floor operations. This results in the creation of interactive, responsive manufacturing environments that are driven by real-time customer information and coordinated with the realities of actual production capability.

Unifi Technology has developed a rapid deployment methodology based on Solution Sets that reduce implementation time and cost. The company resources are distributed across eight worldwide offices and support centers in North America and Europe.

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Software Toolbox Inc.
Company Overview

Software Toolbox Inc. is an independent provider of software components and tools that assists companies in reducing the cost of making the software connection between manufacturing control systems and Manufacturing Execution Software (MES).

Companies such as Unifi Technology Group employ technologies and expertise from Software Toolbox Inc. to deal with the detailed technical issues associated with control system connectivity.

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