

E-MANUFACTURING & SAP-CREATING RESPONSIVE SHOP FLOOR IN THE SUPPLY CHAIN

Traditionally, the shop floor was isolated from the rest of the supply chain and within the organization. Businesses that harness the power of the Internet are making huge gains in efficiency, both by reducing the friction inside their own business and by binding suppliers more tightly into the supply chain. E-Manufacturing covers a single, complete set of operational capabilities including rapid plant design and deployment, real-time ERP connectivity, comprehensive asset management of people, products and processes, and a seamless coupling to the entire supply chain via the Web.

E-manufacturing integrates customers, e-commerce systems, and suppliers into the manufacturing process to provide an Internet-based strategic framework for the factory. This white paper discusses the concept, history & evolution of e-manufacturing, implementation footprint, SAP and e-manufacturing. The concept of e-manufacturing is extended to using SAP as the vehicle to get the business integrated to the whole of the supply chain.



WHITEPAPER



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INTRODUCTION

Traditionally, the visibility of the shop floor was very limited in the supply chain and within the organization. With the evolution of e-commerce, there is a constant urge of business managers to quickly respond to the customer demand than ever. These managers attempt to balance customers' demands for shorter lead times, smaller batches and lower costs with the need to understand the true capacity of the plant and so find ways to make it more efficient.

In today's tightly integrated supply chains, the factory floor is still where the value is added in every manufacturing enterprise. In these models, it is essential to make the connection from the shop floor to the top floor where management decisions are made. And this connection has to be very quick in response to the changes in the markets. The answer for this lies in bringing the shop floor in limelight and therein lays the opportunity in e-manufacturing.

What then does e-manufacturing mean? "The core of [a] manufacturing strategy is the technology roadmap for information transparency between the customer, manufacturing operations, and suppliers. An e-Manufacturing strategy takes e-business processes, such as build to order and reliability centered maintenance, and generates guidelines for implementing plant systems. The e-manufacturing strategy takes the e-business and manufacturing strategies and creates a roadmap for system development and implementation in the plant." (AMR Research, August 2000).

Enormous amount of data is generated in today's factory. But the problem managers faced in the past was 'haystack syndrome' i.e. finding the useful information. But with the modern industrial automation hardware, powered by advanced control software and inter-connected by open networks, it is possible to provide a wealth of information on the manufacturing process whenever required. On one level, e-manufacturing bridges the gap between shop floor and top floor systems, yet it is a concept much greater than the sum of its parts. It covers a single, complete set of operational capabilities including rapid plant design and deployment, real-time ERP connectivity, comprehensive asset management of people, products and processes, and a seamless coupling to the entire supply chain via the Web. Businesses that harness the power of the Internet are making huge gains in efficiency, both by reducing the friction inside their own business and by binding suppliers more tightly into the supply chain.

E-manufacturing integrates customers, e-commerce systems, and suppliers into the manufacturing process to provide an Internet-based strategic framework for the factory. Most prevalent in the high-tech industry, e-manufacturing is gaining ground in other industries as companies integrate the Internet into their manufacturing operations, leading to increased agility and profitability as well as reduced lead times. The essentials of e-manufacturing are shown in Figure 1 which represents the structure built with various components.

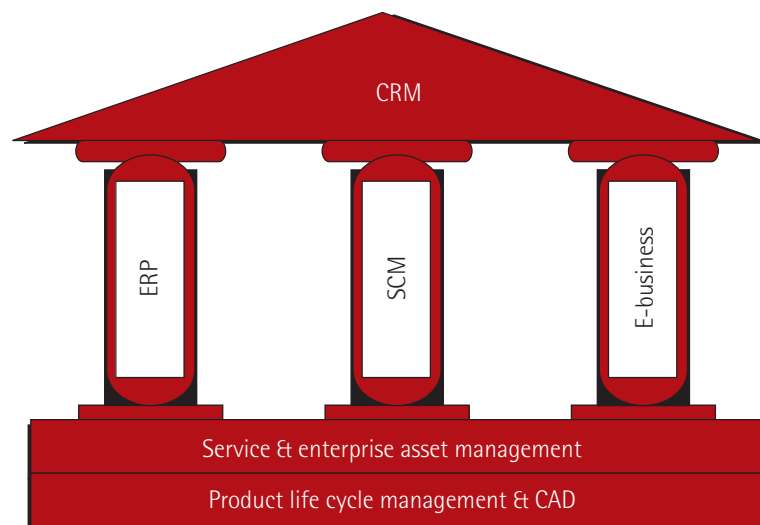


Figure 1: The essentials of e-manufacturing



MANUFACTURING TRANSFORMATION

As the older manufacturing models do not allow for the heightened flexibility and modularity necessary to meet the demands of customers and their changing needs, manufacturing is moving from 'make to forecast' to 'make to order scenarios'. The foundation for e-manufacturing is based on a pull system in which products are made to order, thereby allowing companies to customize their offerings to meet specific demands. Companies can manufacture their products more efficiently by moving away from building work-in-process and finished goods in excess of actual demand. Though manufacturing forecasts still play a role in the process and unforeseen swings will still cause disparity between supply and demand, E-manufacturing helps to minimize these situations.

In a true make-to-order system with Web-based order-entry, forecasting accuracy is still relevant to anticipate big-picture future demand. But all systems and resources must allow for - and actually promote - significant daily swings in production. A company's strategy must include a notification system that utilizes the correct amount of human, machine, and material resources. For many years, models like lean manufacturing, agile manufacturing, and constraint management have led the effort to convert mass production to more flexible, responsive, and cost-effective methods. Both lean and agile manufacturing promote the idea of producing only what's needed - no more, no less - while maintaining minimal or zero finished-goods inventory. Constraint management focuses on eliminating production holdups by optimizing the material flow through bottlenecks. Success depends on the ability to forecast future demand and produce to that forecast.

The solution is e-manufacturing, the next logical stage in the manufacturing evolution, which applies Web-based applications, emerging technologies, and new developments in enterprise resource planning (ERP) systems to the manufacturing models. This new model integrates customers, e-commerce systems, suppliers, PLM and CAD into the manufacturing process to provide an Internet-based strategic framework for the factory.

e-Manufacturing Footprint

e-manufacturing is all about the increasing need for communications to and from the factory floor. Manufacturers need systems that can reveal available capacity, status of orders, and quality of a product - not just after it comes off the line, but while it is in process. The e-manufacturing journey begins by recognizing the need for creating a seamless flow of information from the factory floor. While electronic management of manufacturing functions such as maintenance offers big cost and time savings, the greater strategic value may lie in the new options electronic information provides to executives. For example, collecting plant data centrally also facilitates the ability of managers to assign work based on which a plant can deliver the quickest response time or the lowest cost of production at a particular point in time. By pushing data from circuit monitors and PLCs scattered across multiple plant sites to a central location, companies now can do a better job of assigning energy expenses to individual cost centers, analyzing energy usage trend data, and assigning orders to plants to take advantage of hourly fluctuations in utility rates.

Success in Web enabling the factory also hinges on the work culture's familiarity with e-business. A company that isn't using the Web for purchasing, for example, is unlikely to embrace the idea of e-enabling its plants. Manufacturers should start small and build the success that will bring support. The greatest culture challenge lies in closing the cultural chasm between IT and the production floor.

A company today can now have a single, complete set of operational capabilities including rapid plant design and deployment, real-time ERP connectivity, comprehensive asset management (of people, products, and processes), and a seamless coupling to the entire supply chain via the Web. That's what e-manufacturing really is about.



E-manufacturing works best in situations in which a company can manufacture a small number of base products to an intermediate step, postponing the completion of the manufacturing process until the customer orders the customized product. As a result, most current manufacturing efforts are concentrated in the technology sector, where product customization is the norm.

e-manufacturing growth is slow, due in large part the change-resistant nature of the manufacturing industry overall. According to Gartner, only 1% of U.S. companies currently have full e-manufacturing implementations, although that number is expected to increase to 15% by 2004. There are a few exceptions though, Companies such as Dell and Hewlett-Packard, along with their major suppliers, have long utilized e-manufacturing to meet their customer needs. Once a consumer has chosen and ordered a customized PC, final production begins and the product is shipped. By postponing final assembly by waiting to load software and memory into certain networking devices until it receives a customer order, Cisco Systems minimizes finished-goods inventory and maximizes flexibility.

REQUIREMENTS FOR E-MANUFACTURING SUCCESS

- 1. Business processes & production must be synchronized.** E-manufacturers must raise the visibility of manufacturing information to optimize performance, enhance responsiveness, and manage costs. Those who leverage manufacturing data to continuously improve their own operations and to enhance those of their suppliers and customers will be the winners.
- 2. Collaboration of supply chain.** Plants need to utilize supply chain planning systems and procurement systems to improve their overall supply chain performance. The goal is to leverage this information in real time to work against actual demand rather than forecasts of anticipated demand. Marketplaces and trading exchanges, he believes, are the frontier for collaboration and the real-time exchange of information across trading networks.
- 3. Inter & extra enterprise business processes and workflows automation.** Manufacturing managers need new tools that allow them to have visibility into events as they occur, and the ability to impact those events to add value. The business processes and workflows within the enterprise and across the value chain needs to be automated.
- 4. Plant information and analysis tools dashboard.** New Internet-based tools allow e-manufacturing managers to visualize information from a variety of systems throughout the enterprise, and interpret the results in conjunction with established performance metrics.
- 5. Integrate the design process among all collaborating parties.** The manufacturing process begins well before the line ever starts to run. New internet-based tools are emerging to support collaborative design and engineering processes.
- 6. Leverage bi-directional information with customers & suppliers.** The essence of collaboration is the ability for individual plants to schedule their work in real time based on accepted orders, and to coordinate the delivery of component materials needed at the production level to meet those schedules. That involves sharing not only with suppliers, but providing visibility into the manufacturing process to customers, while gaining visibility into real-time demand from customers.

e-manufacturing & SAP Solution:

The components of e-manufacturing are:

- a) PLM
- b) E-business
- c) SCM
- d) CRM
- e) Service & EAM



Now let's discuss how these components, to a great extent, are mapped to the various integrated components of one of the widely used software viz. SAP.

SAP & e-manufacturing

SAP today offers following components for implementation of e-manufacturing concept.

- PLM
- R/3-ERP
- APO for SCM
- CRM
- SRM for e-procurement.

Following diagram can represent the holistic view of the above components. In following sections we will discuss each of these components.

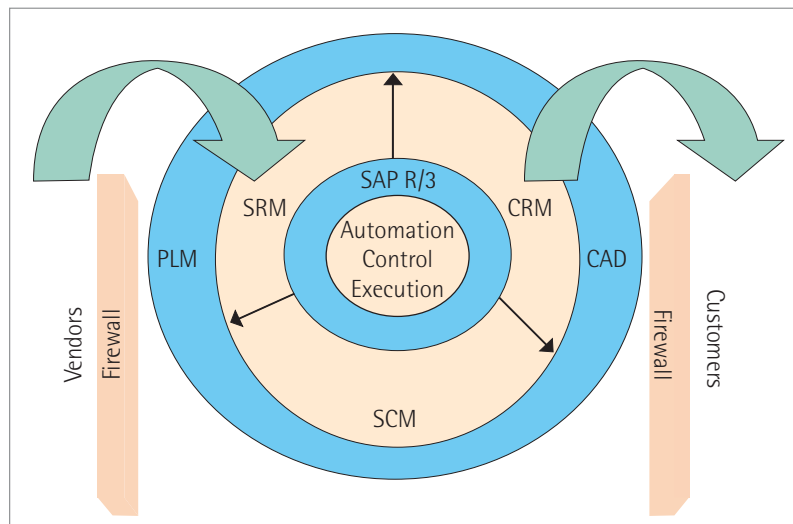


Figure 2: The components of e-manufacturing



At the core of this diagram are the shop floor automation systems viz. PLCs, Sensors, field devices etc. which can be integrated with the core SAP component viz. R/3. On the next layer is the Sap's core software i.e. R/3. The next layer consists of SRM (Supplier relationship management), CRM (Customer relationship management) & SCM (Supply chain management).

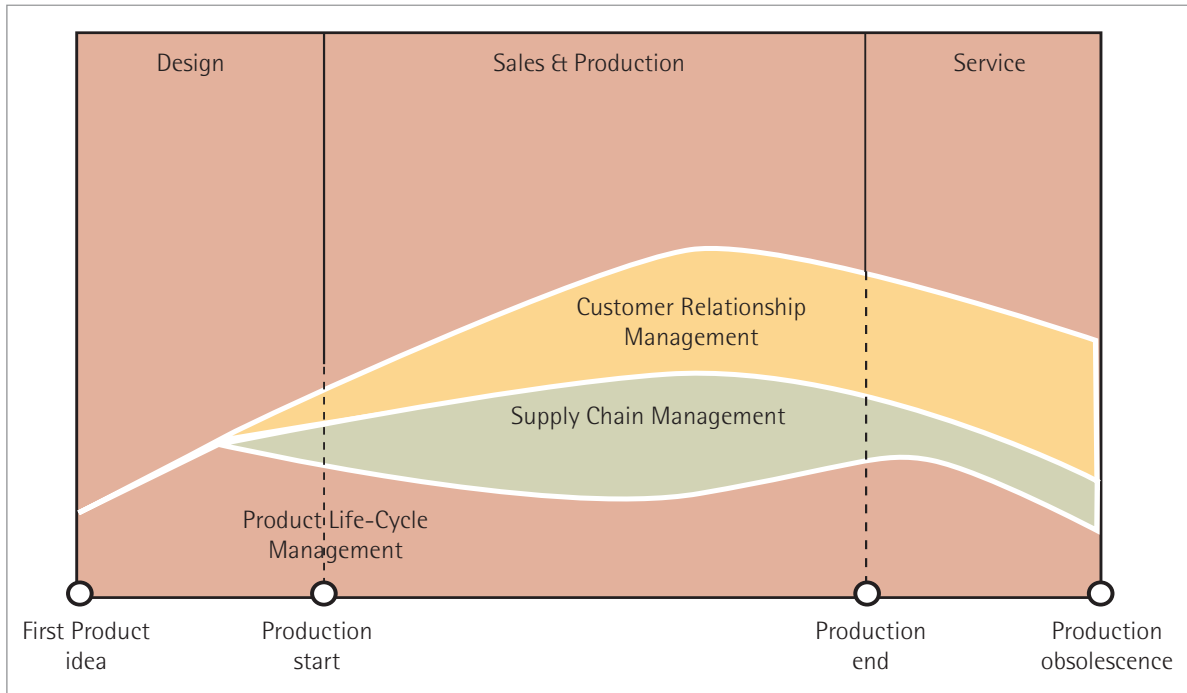


Figure 3: The role of each component in various stages of e-manufacturing

Product lifecycle management encompasses all these components as it exists from the inception of the idea of a new product till its death. PLM can be integrated with the CAD systems. There are two most important entities exists in e-manufacturing viz. the vendor's systems & customer's systems. With the help of the firewalls the systems of vendor & customer can be integrated easily.

Interplay of SCM, CRM & PLM

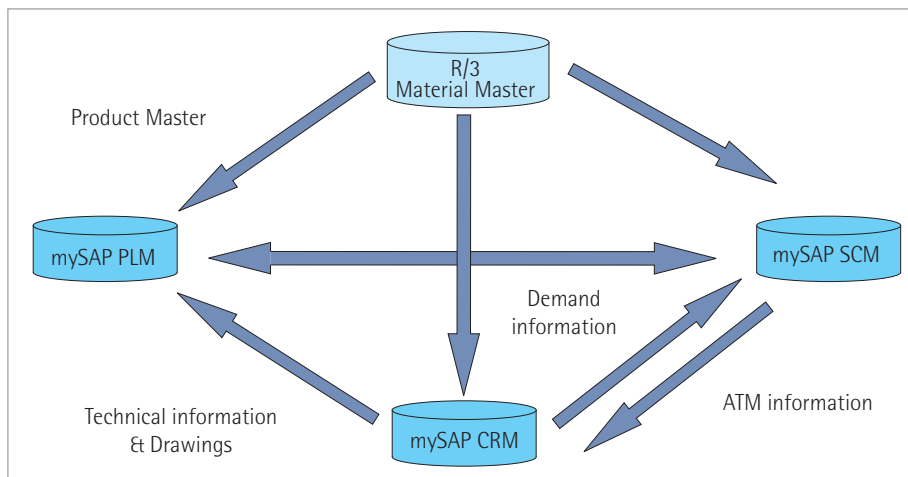


Figure 4: Interplay of SCM, CRM & PLM



The typical business flow will be as follows in an 'e' enabled manufacturing environment.

The R&D and marketing department will work closely to develop a product using SAP PLM. During the development the vendor development also takes place using SAP SRM. Once the product comes in to manufacturing then the SCM starts planning according to the "Make-to-Order" strategy. The CRM now gets the inputs like drawing/photos of the products which can be accessed by the potential customer for ordering purpose. Any changes or modification required can be immediately carried out by using CRM-PLM-CAD interface.

mySAP PLM overview

PLM handles following areas:

- a) New product development & document management
- b) Product change management & gearing up the production
- c) Maintenance management – including service management
- d) Asset lifecycle management
- e) Asset operation
- f) Asset replacement

PLM helps in

- a) Reducing cost-to-market by efficiently managing the cost of changes & project management of new product developments.
- b) Improved availability of assets within the given maintenance & service budget.
- c) Reduced total cost of ownership through integration with CAD, CRM, SCM & SRM.

mySAP SCM overview

SAP SCM has following components.

- a) APO – Advance planning & optimization.
- b) EM: Event management
- c) ICH: Inventory collaboration hub

APO has following components:

- a) Demand planning: In this, component system identifies and analyzes patterns and fluctuations in demand, and creates accurate, dynamic demand forecasts.
- b) Supply Network planning: Matches purchasing, production and transportation processes to demand, and balances and optimizes your entire supply network.
- c) Production Planning & detailed scheduling: Optimizes the use of resources and creates accurate plant-by-plant production schedules in order to shorten production life-cycles and responds rapidly to changes in market demands forecasts.
- d) Global available-to-promise: Matches supply to demand on a truly world-wide scale, and gives your customers reliable delivery commitments by means of both real-time checks and sophisticated simulation methods.



mySAP SRM overview

mySAP SRM has following components to take care of the e-business side of the procurement function in e-manufacturing.

- a) EBP – Enterprise buyer
- b) Catalog engine
- c) Supplier self service
- d) Bidding engine

Due to SRM it is very easy to automate the entire procurement process and reduce the paper work drastically e.g., there is no need to send the fax or physical copy of PO to vendor. It can be mailed to him in his mailbox. Also supplier can login into the system to check the status. The security of the data can be taken care by firewall between the vendor's system and the SRM.

In a nutshell, SRM offers the following:

- Efficient procurement process
- Optimal supplier management
- Focus on sourcing strategy

mySAP CRM overview

mySAP CRM offers following components to take care of the customer angle of the e-manufacturing.

- Internet sales
- Telesales
- Mobile sales & service
- Customer interaction centre
- Integration with other systems like R/3, APO & BW.

Due to CRM the complete sales process is covered via internet. This internet sales takes care of marketing, order management, fulfillment etc. CIC (Customer interaction centre) provides inbound and outbound call processing, e-mail management, activity management to track, monitor and enhance all customer contact. It supports multiple channels for customer communication, including telephony and Web. The other component of CRM i.e. mobile sales delivers key customer and prospect information to sales personnel at any place, at any time; facilitates planning and maintenance of sales activities, such as appointments, visits, and calls; and provides activity reports. It creates quotations and takes orders; includes support for mobile and wireless devices. Thus the 'customer' angle of e-manufacturing is taken care by CRM.



TCO FOR E-MANUFACTURING

If we observe the evolution of SAP it can be seen that in the past SAP systems have been integrated with other legacy systems e.g. using middleware tools to legacy systems. This has increased the total cost of ownership of the systems. With the new concept of separating the application & the Technology layers, SAP's NetWeaver helps in reducing the TCO drastically. So the effect is companies can implement the e-manufacturing concept with the help of SAP system with lesser & lesser TCO.

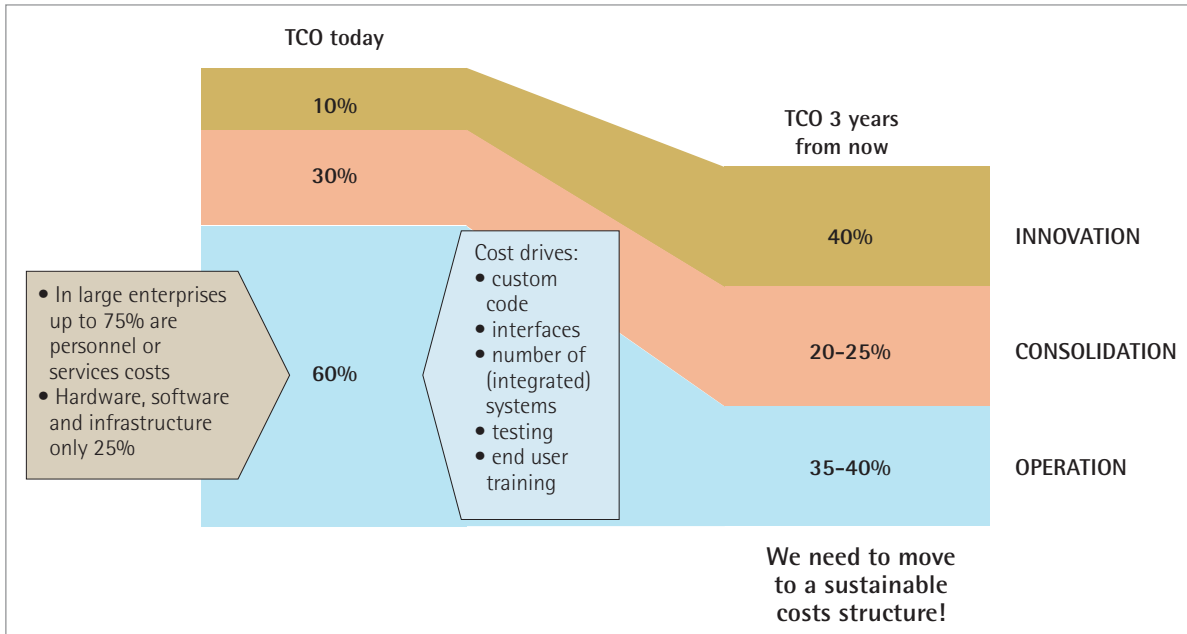


Figure 5: TCO for e-manufacturing

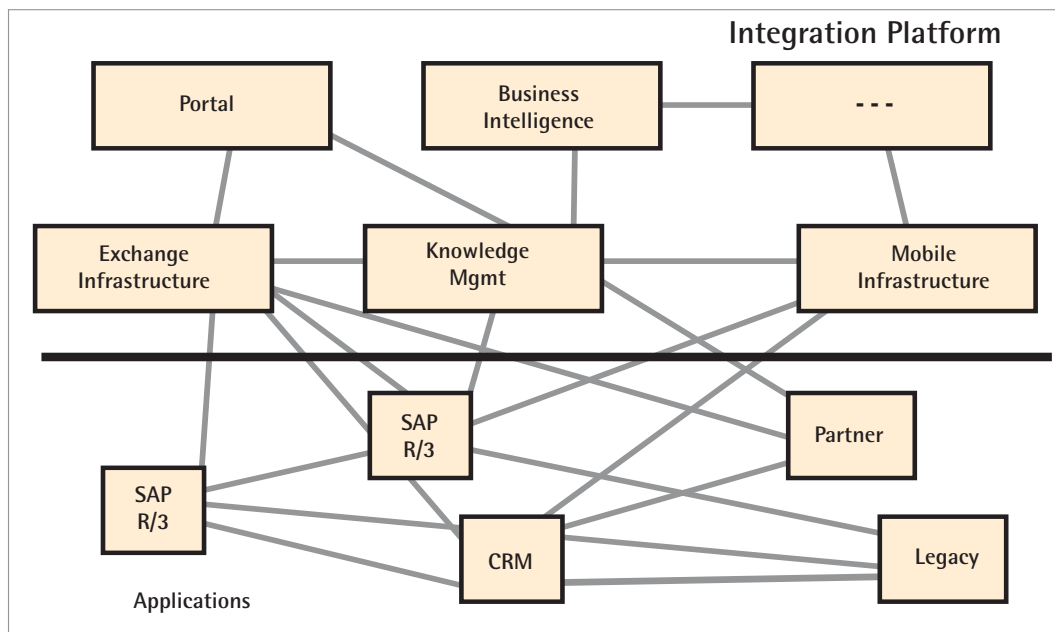


Figure 6: Implementations of SAP in the industry



We can observe that there are many other legacy systems integrated with the SAP systems. This increases the maintenance of these systems and the TCO for implementing e-manufacturing. But with SAP's NetWeaver the typical scenario will change as indicated below.

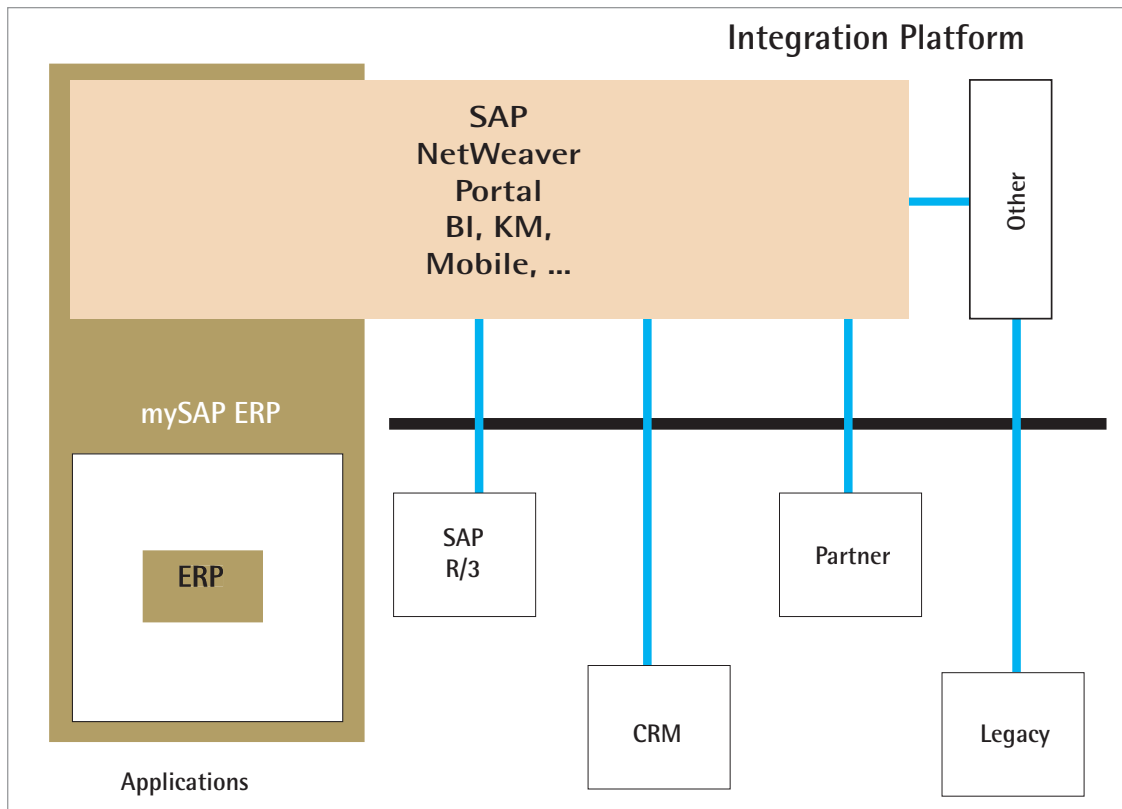


Figure 7: SAP NetWeaver

As one can see the integration with other legacy system can be done through one tool i.e. NetWeaver - be it any legacy system. The major benefits of SAP NetWeaver from e-manufacturing point of view are:

- It leverages the SAP's core strength and existing investments in SAP
- It's an integrated out of box tool
- It's a foundation to serve all application needs
- Integration with non-SAP system is easy

So with NetWeaver coming into picture the implantation of e-manufacturing is made further achievable in the time to come.



ROADMAP FOR E-MANUFACTURING

1. Embrace the Internet.

All parties in the company must recognize the organizational change required to adopt an e-manufacturing strategy – and the greater influence of the Internet and of customer demand.

2. Plant engineers have an important place in decision-making process.

Plant engineers bring expertise in plant-floor processes, as well as the information available (and required) for seamless integration. Their plant floor experience and perspective will prove to be invaluable as e-manufacturing efforts proceed.

3. Build an internal team, and draw the company's roadmap for e-manufacturing.

Draw from various departments and functions within the organization, and discuss the common and specialized benefits each would receive from information transparency. Each segment of the organization should have a vision for success reliant on information transparency.

4. Find a company leader to serve as champion.

Whenever possible, secure the CEO as the e-manufacturing driver for the enterprise. If an e-business strategy is in place for the company, it's especially critical to be sure that e-manufacturing is a key element of that broader strategy. Thus, the e-commerce director or CIO is another good champion to enlist.

5. Take one step at a time on the roadmap.

Don't attempt to do everything at once – that is a lesson to be learned from the original ERP implementations. It took many years for plant floor, front office, and supply chain to evolve to where they are today; take a logical path to evolve them via e-manufacturing, and measure successes along the way.

6. Measure the success and failure of the roadmap.

Put metrics in place to determine the real savings and efficiencies from a transparent enterprise.

7. Evaluate your traditional channels – and listen to their needs.

Analyze the ways the company works with customers, suppliers, distributors, and others to determine their effectiveness, and find ways to streamline relationships and processes.

8. Build on your existing foundations, and on your incremental successes along the way.

An e-manufacturing strategy will help your organization embrace information transparency that will foster operational excellence, while not creating more work, major overhauls, or enormous investments. It won't happen all at once, but once you begin, your organization can build upon the successes until the full e-manufacturing approach is realized – and the organization excels in its own design, operations, maintenance, and synchronizes competencies.

9. Get help from an expert.

Consider the outsourcing trend in manufacturing. When competition and pressure for bottom-line performance are high, companies outsource basic production, manufacturing engineering, automation engineering and other capabilities to suppliers that specialize in these competencies. Employ experts for the implementation.



CONCLUSION

The companies embarking on the e-manufacturing journey can make a start from their existing stage. The companies already having implemented the SAP ERP system can be the forerunners of the e-manufacturing journey. However they should plan their journey carefully and follow a step by step approach to succeed in the strategy. Given below is the Roadmap for e-manufacturing.

GLOSSARY

TCO: Total cost of ownership

PLC: Programmable logic controllers

PLM: Product life cycle management

SCM: Supply chain management

CRM: Customer relationship management

EAM: Enterprise asset management

APO: Advance planning & optimization

SRM: Supplier relationship management

EM: Event management

ICH: Inventory collaboration hub

EBP: Enterprise buyer professional

BW: Business Information warehouse

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