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Application of Internet to Manufacturing Technology: E-Manufacturing Approach

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Abstract--With a rapid vicissitude in technology, especially in the manufacturing sector, customers are authoritatively mandating more value, less peril, and better integration of products, hence there is a desideratum to transmute the manufacturing strategies, which can result in ameliorated performance thereby meeting the customer demands. This paper critically reviews an incipient area to surmount the above quandary called “E - Manufacturing” which can integrate customers, products and suppliers with the avail of Internet Technology. The concept of E - Manufacturing, its development, implements and potential benefits are discussed along with application examples on Automobiles. Areas like E - Maintenance, E - Diagnostics, E - Business cognate to E - Manufacturing is additionally discussed. By adopting such a manufacturing technique, zero downtime, reduced product error, customer gratification; expeditious manufacturing changes can be accomplished. In integration the concept of E-Manufacturing applied to the manufacture of gears is additionally discussed there by providing better understanding of this process.

Keywords--E - Manufacturing, E - Maintenance, E -Diagnostics, E-Business

I. INTRODUCTION

Today’s manufacturing companies what matters more is that how efficiently their company can compete ecumenically with others as an organization followed by meeting the day to day requisites of the customer and exchange of hassle free information while not focusing only on sales of the company [1]. Today’s customers provide top priority for mazuma, better quality and less peril. In order to cater to the desiderata of the customer, manufacturing companies have adopted an incipient technique called E Manufacturing. It is concerned with the utilization of the Internet and E-Business technologies in manufacturing industries wherein a network can be established between the customer, the manufacturer and the product. The cyber world offers a frictionless path for the exchange of information. The concepts of E-Maintenance, E-Business, E-Diagnostics and E-Care have led to the formation of an E-Factory which can engender quality products at remarkable speeds. In short, the customer is just a click away from a business deal. Within manufacturing concerns, the sundry enterprise-wide systems like ERP, MES, SCADA, and even more incipient acronyms like Enterprise Asset Management (EAM) and Product Lifecycle Management (PLM) are communicating with each other, and sharing data through internet connections.

II. EVOLUTION OF E-MANUFACTURING

For decades, the ascendant manufacturing model was predicated on the principles of mass engenderment [2]. Standardized components and processes made the economies of scale achievable, but constrained design flexibility and customization. The outsourcing and lean manufacturing forms of kineticism of the 1980s and 1990s drove the emergence of an incipient paradigm, termed the Quality Management era. Manufacturing companies, concretely sizably voluminous Pristine Equipment Manufacturers’ (OEM) outsourcing shifts critical elements of the design and engenderment process onto a manufacturer’s supply chain.

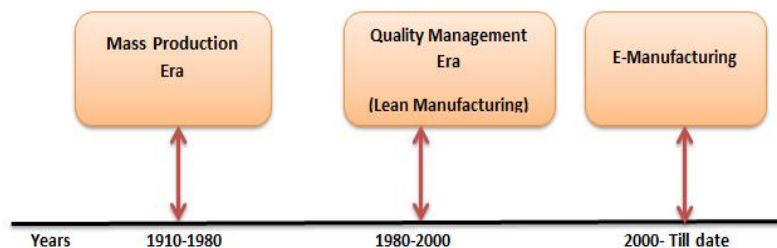


Figure 1.Evolution of E-Manufacturing

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The lean manufacturing kineticism places a premium on time and inventory reduction. Amalgamating the attributes of the Quality era suggests a very different business model for manufacturing – enterprise integration or E-Manufacturing. In the E-Manufacturing era, companies will be able to exchange information of all types with their suppliers at the speed of light.

III. E-MANUFACTURING

E-Manufacturing can be most cogently and generally described as the application of the Internet to Manufacturing [3], further E-Manufacturing is propagated with the incremented utilization of the cyber world. Due the widespread availability of the Internet; astronomically immense-scale distributed projects in manufacturing are propagating. It is the methodology and framework for collaborative Virtual Manufacturing. The ability to exchange information and automate manufacturing processes, forms the building blocks of the virtual manufacturing companies of the near future. It covers all aspects of manufacturing - sales, marketing, customer accommodation, incipient product development, procurement, supplier relationships and logistics manufacturing strategy development and so on. As a result, it is now so much more facile to sanction certain people gain access to certain sections of the system, according to whatever criteria they like; maintenance people need certain components of the data, but not others; operators would be able to access a circumscribed number of contrivances; managers would be sanctioned to monitor, but not transmit anything, etc. Incipient technologies such as the Extensible Markup Language (XML) are now making it more facile to apportion data between different application programs, and to establish computers to take actions predicated on criteria < for instance, to inductively authorize supplies when inventories reach a critical low point. The E-Manufacturing technique additionally affects products as well since it is possible to utilize Internet technologies to integrate incipient product functions and to provide incipient accommodations. The Cyber World is being used even at the shop floor level. For instance, computer numerical control contrivances (CNC's) can be connected via intranets or the Internet to ERP (Enterprise Resource Orchestrating), engenderment orchestrating, or maintenance systems. As such, the E-Manufacturing project aims to develop a felicitous framework for a prevalent platform to enable distributed orchestrating and control in manufacturing for more expeditious, more facile, secure and cost-efficacious collaborations. The developed system will sanction dispersed engineering team members to collaborate productively, as if they were under one roof. This transformation of the enterprise coincides with the incrementing content of information contained in products and processes. This incipient engenderment enterprise is an information-affluent. The major functions and objectives of e-manufacturing area: (a) Provide a transparent, seamless and automated information exchange process to enable an only handle information once (OHIO) environment; (b) Improve the utilization of plant floor assets utilizing a holistic approach amalgamating the implements of predictive maintenance techniques; (c) Links entire SCM operation and asset optimization; and (d) Distribute customer accommodations utilizing the latest predictive perspicacity methods and Tether-free technologies [4].

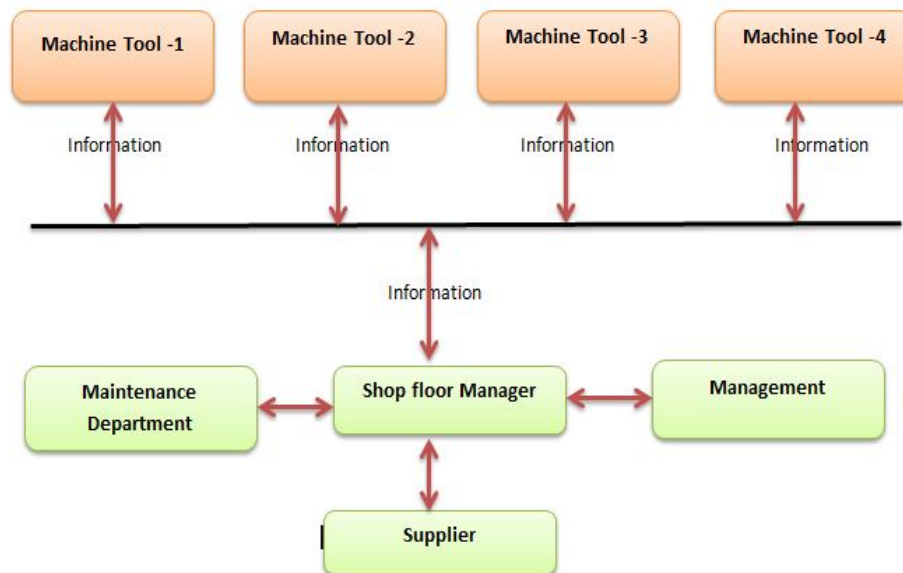


Figure 2. Application of E-Manufacturing

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IV. E-MANUFACTURING TOOLS

Implementation of the E-Manufacturing implements results in cost preserving, regardless of the company size. E-Manufacturing implements enable connectivity among the sundry modules of the manufacturing process. Areas where the E-Manufacturing implements need to be developed are listed below [5 - 9].

A. Data and Information Transformation Implement

The plethoras of raw data accumulated during a manufacturing process are rendered useless, unless the data is accumulated and transformed into some utilizable information which may be habituated to monitor a system. To understand this better a simple example is taken below. Consider a CNC machine hooked to the Internet as shown in Figure 4. It shows the way data and information are transformed from the machine to in the cyber world. Here the conception is to monitor the health of the implement [life of the implement] fine-tuned in the CNC machine. This technique can withal be acclimated to calibrate a machine from the Internet.

B. Prognostication Implements

Apart from data being amassed, certain implements need to be developed, which can prognosticate or detect the degradation of sundry components of the machine, performance loss and trend of failure. Developing an implement which monitors these aspects could set the trend for an advanced diagnostic system.

C. Optimization Implements

As far as E-Manufacturing is concerned data can be accessed from any component of the globe at any time. Hence certain implements need to be developed which can optimize the data and provide facile to read results. For example, these implements should be able to provide the performance of a drill bit for sundry drilling operation verses time, temperature, implement tip failure with sundry materials etc.

D. Synchronization Implements

This is a consequential implement in the E-Manufacturing environment, which can associate sundry groups such as customer's suppliers and manufacturers, where firsthand information needs to be sent to these groups during emergencies, for example – if implement needs a separation or implement has jaded then the information is sent from first the manufacturer to the supplier and implement maker where the implement can be assessed for performance. The incipient connectivity and communications implement will boost productivity, profits, speed to market, and flexibility for those manufacturers who are disposed to upgrade. Some of the prevalent E-manufacturing implements are SMS, E Mail, Bluetooth, Wi-Fi, Fax and Infrared Connectivity.

V. E-MAINTENANCE

Progressive plant executives, maintenance managers, and work planners have always wanted to have information about the condition of equipment assets at their fingertips when they require it. Lamentably, it typically is scattered among separate information systems. It is arduous to view, compile and synchronize the different information types on the same computer terminal. If one wants to maximize business continuity by incrementing contrivance up-time and minimize the time, costs and headaches associated with contrivance administration he must adopt the E-Maintenance strategy. It is a network that integrates and synchronizes the sundry maintenance and reliability applications to accumulate and distribute asset information where it is needed, when it is needed. Interconnectivity of the islands of maintenance and reliability information is embodied in E-Maintenance. The E-Maintenance network can be developed from an accumulation of information islands by utilizing a single proprietary system, a custom bridge, or by utilizing an open systems bridge. E-Maintenance additionally abstracts the desideratum for manual meter readings that is your contrivance administration is virtually reduced to nil. It is estimated that 15- 40% of indirect costs of manufacturing is maintenance cognate. About 50% are dispensable corrective maintenance, which costs 10-15 times more than predictive maintenance. Furthermore, 25% of maintenance is preventive, which is 3-5 times more sumptuous than predictive. An efficacious E-Manufacturing strategy uses predictive maintenance techniques to forecast equipment wear and prognosticate failure. Apart from this, it additionally alerts MRO managers to unexpected quandaries. This sanction managers to proactively correct quandaries, thus maximizing the utilization of machinery and personnel while minimizing preventive maintenance expenses. Soothsaying the reliability of plant-floor equipment can be the distinction between a few minutes of preventive maintenance and

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hours or days of downtime for corrective maintenance. Ultimately, predictive maintenance, computerized maintenance management systems or CMMS, and efficacious utilization of maintenance specialists make E Manufacturing work.

VI. E-DIAGNOSTICS

E-Diagnostics is the reactive and proactive remote diagnosis, maintenance and rehabilitation of equipment by accommodation personnel. E-Diagnostics offers many businesses the promise of better equipment reliability and performance at a much lower cost. It is the hardened, reliable acquisition of time-stamped, high speed information from the implement registers and ancillary data points, database retention and management, parsing and analysis. A consummate E-Diagnostics solution would include the following:

Remotely capture, transmission, analysis and dissemination of equipment performance data.

Remote takeover of equipment to manipulate equipment settings during and after repair.

A trigger for replenishing spare components.

More expeditious and more efficacious replication to field accommodation engineering requests, bringing the experts remotely to the quandary.

Reduced equipment and process variation, through better overtness and replication to differences in equipment performance among machines.

Preventive replication to pending equipment failures through the utilization of advanced process control (authentic-time multivariate statistical analysis).

Enhanced next-generation, implement development through ameliorated vigilance of deficiencies in current equipment designs.

Traditional E-Diagnostics systems monitor, implement performance and provide "maintenance needed" alerts to accommodation and engineering personnel. Much more can be derived from the affluent sensor data engendered as wafers pass through process chambers. This step in E-Diagnostics is to employ proven enterprise data mining (EDM) techniques to correlate contrivance yield and performance with the astronomical amount of implement-level and wafer-level chamber sensor data. With this incipient approach, yield and process-level issues can be unearthed down to a particular sensor reading on a concrete implement process chamber. Once a categorical implement issue can be identified to have an impact on process results, categorical E-Diagnostics monitors can be targeted to obviate future yield and process excursions, consummating a closed loop process learning effort. The steps to be followed to implement the E Diagnostics strategy in an industry are as shown below.

VII. E-BUSINESS

In today's world, it's the "Time Factor" that can make or break an industry. Gone are the days of buying different applications from a host of technology vendors and spending countless months and dollars integrating them? Increasingly, the customers are authoritatively mandating more customized products, more expeditious distribution schedules, and instant access to objectively authorize status. Results have to be assessed in financial terms, with return on net assets or return on capital employed, the key measure. E-Business promises a solution to this customer inductively authorizing market. Automated scheduling provides a better method of managing engenderment orders and increases the overtness of current and future scheduling activities. Tracking involves the accumulation, analysis, viewing and reporting of engenderment data. To get the best productivity from the assets deployed, three main areas need to be addressed: Condition predicated maintenance; computerized maintenance management; E-Procurement. Condition-predicated maintenance soothes the deterioration of assets that sanctions the orchestrating of maintenance actions more efficaciously and monitors the efficacy of the maintenance program. Computerized maintenance management systems optimize the deployment of all maintenance, repair, and operating (MRO) resources, such as people, spare components, implements and facilities, and sanction the engenderment of an orchestrated maintenance program for all assets. E-Procurement sanctions the separation of stocked with information and offers direct access to spares at the lowest cost. For the prosperous application of E-Manufacturing there must subsist a partnership between the supplier and the customer. The goal is to deploy best practices in e-business processes as expeditiously and efficaciously as possible while ascertaining a quantifiable return on investment (ROI).

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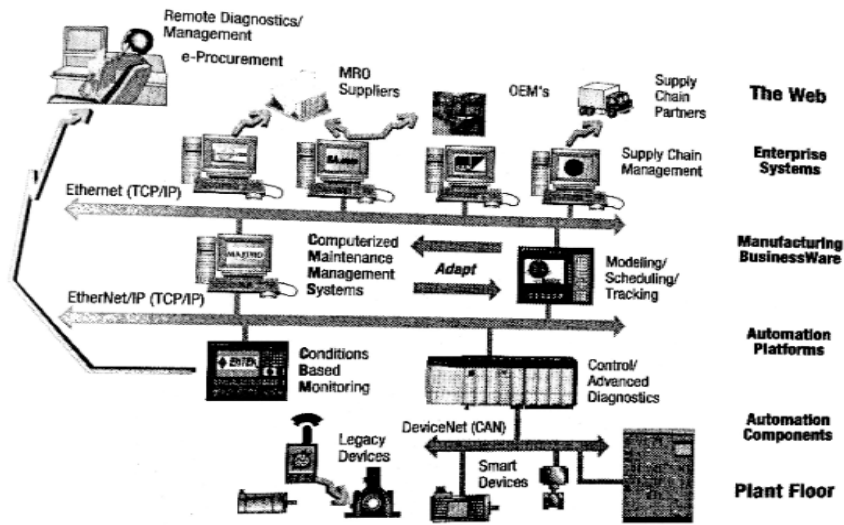


Figure 3.E-Manufacturing and E-Business [3]

The benefits of adopting E- business strategy are;
Quick installation of software updates with no need for expensive integration projects.
One enterprise wide view of the customer, product or process.
Global deployment from one instance of the software, making all applications accessible globally via a standard Web browser.
Simplified systems and maintenance for IT staff due to the one-vendor approach.
Streamlined business processes.
Better decision-making and business intelligence because of the single-database architecture and pre-integrated applications and rapid deployment at lower cost.

VIII. AUTOMOBILE INDUSTRY AND GEARS

Every automobile industry has an umpteen number of divisions, each division manufacturing a particular system of the automobile-like the steering system, brake system, engine, suspension, chassis and body, interiors, safety division, quality control division, etc. With so many departments working towards the engenderment of the same end product, a plethora of time and Mazuma is spent in redesigning and cognate cases which may arise due to inefficient data transfer or delayed transfer of paramount information between the departments. Such a quandary can be sorted out by implementing the E-Manufacturing strategy in the industry. The cyber world can be habituated to apportion data and information between sundry departments and between manufacturers ecumenical. Data sharing can be extensively used between the head office and the sundry branches and accommodation centers of a company which may be located at different locations around the globe. For example, if a component is found defective in one of the branches the information is relayed immediately to the other branches warning them to apprehend the engenderment of that component immediately. As a result of this, immensely colossal amounts of time, material and Mazuma are preserved. The cyber world is an expedient of communication between engenderment engineers, the manufacturing engineers, and the design engineers. Adopting this incipient technique can reduce the involution of the component, without jeopardizing performance. Utilizing CAE implements in the design process may have a profound impact on savings. In many cases, the virtual prototype is a much more precise representation of what we designed than the physical prototype. Apart from adopting this strategy in the engenderment line it can withal be utilized in the maintenance program of an automobile. For example, if you only repair your car when it breaks down, you face costly corrective maintenance. A preventive maintenance schedule, predicated on the manufacturer's recommendations, may avert breakdowns. Preventive maintenance is possible utilizing E-Diagnostics. When a car is taken in for servicing, it is hooked onto the diagnostic computer which designates subsisting quandaries. Moreover the accommodation centers are perpetually hooked up to the cyber world and are updated on availability of spares, latest trends in servicing and solutions to commonly occurring quandaries. All this information is made available from their counterparts from around the world. To integrate to this the entire accommodation history of the conveyance is uploaded to the net so that it is made available to all of the company's accommodation centers around the globe which will avail identify the status of the conveyance wherever and whenever one wants to accommodation it. Gears form

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a paramount component in most machines as well as in automobiles. Today's Customers demand a multitude of gears in a short span of time, without any compromise on quality. The solution to this challenge is E Manufacturing. One can hook up the gear manufacturing machine to the net. It offers plenary integrated engenderment control software for estimating, order and job control, job peregrinators, scheduling, data amassment, inventory control, purchasing, work center loading and cost accounting. Sundry design parameters can be entered by the customer and modifications may additionally be made until the last minute. Once the system is in place economic and efficient manufacture of gears is imminent.

IX. BENEFITS OF E-MANUFACTURING

E-Manufacturing is a fundamental change in the strategic value proposition for manufacturers. Its collection of systems, processes, and technologies that support and enable manufacturers to compete in collaboration with others has seven fundamental jobs:

Synchronize Production Processes with Business Processes.

Orchestrate Upstream Flows of Work, Information, and Material.

Automate Business Processes & Workflows within the Enterprise

Give Control to Managers with Plant Information & Analysis Tools.

Integrate the Design Process among All Collaborating Parties.

Leverage Bi-directional Down-stream Information.

Enable Collaborative Maintenance and Manufacturing Support.

X. CONCLUSION

This paper discussed certain key areas and subsets of the E-Manufacturing strategy which when implemented will yield priceless benefits to an industry that implements it. Further the concept of an E-Factory promises greater increase in productivity and performance, while at the same time decreases production costs. However, for E-Manufacturing to be a success, co-operation between various public and private sector organizations is mandatory. This new thinking paradigm to integrate web-enabled and predictive intelligence for manufacturing systems is becoming a new benchmark strategy for manufacturing companies to compete in the twenty-first century.

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