Computers In Manufacturing Enterprises

SUPPLY CHAIN AND E-MANUFACTURING

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Supply – Chain Models

Push Model

- manufacturers produced / delivered in terms of size, price, quality, etc based on their own interests
- focus in on process efficiencies, plant throughput and economies of scale

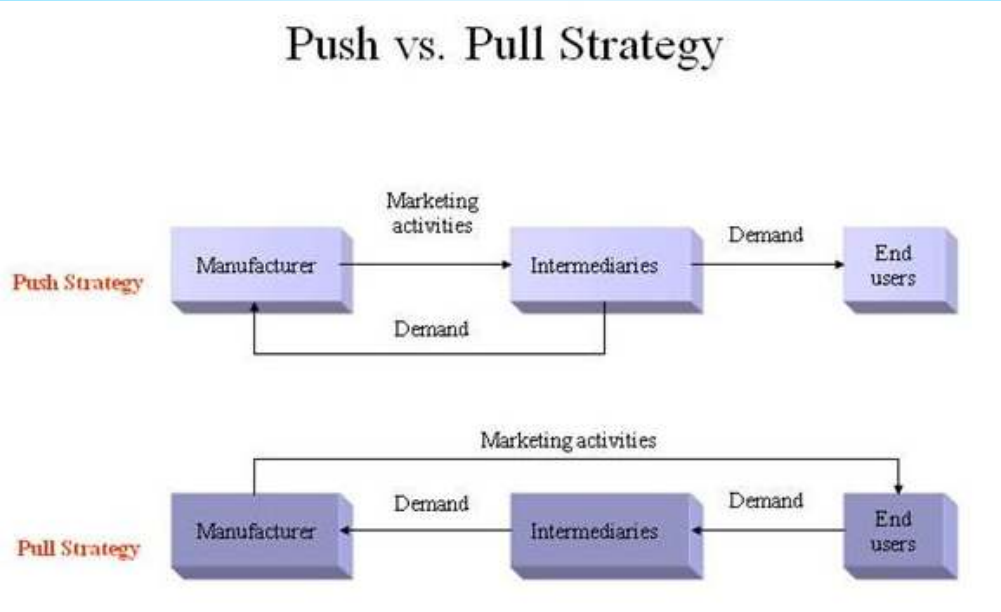
Pull Model

- just-in-time inventory management that minimizes stock on hand, focusing on last-second deliveries
- products enter the supply chain when customer demands it
- companies avoid the cost of carrying inventory that may not sell
- risk is not having enough inventory to meet demand if the production is not accelerated quickly enough

Push/Pull model

- combination of the above 2 models
- For instance, a company may choose to stockpile finished product at its distribution centers to wait for orders that pull them to stores
- Manufacturers might choose to build up inventories of raw materials -- especially those that go up in price -- knowing that they will be able to use them for future production

Practical E-Manufacturing and Supply Chain Management By Gerhard Greeff, Ranjan Ghosha



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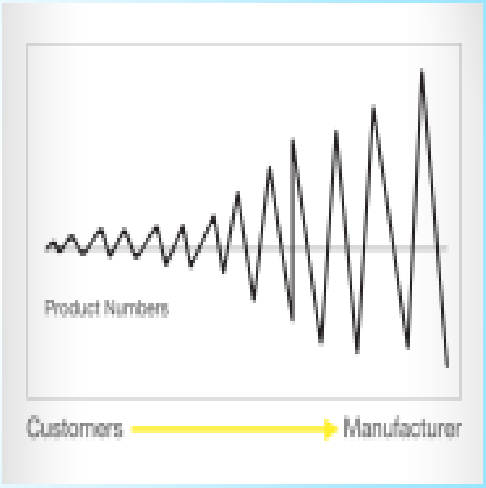
Bullwhip Effect in Supply Chain!

- observed phenomenon in *forecast driven* distribution channels
- also known as *"Forrester Effect"*
- refers to a trend of larger and larger swings in inventory in response to changes in customer demand, as one looks at firms further back in the supply chain for a product
- key example for supply chain inefficiency

	Period 1	Period 2	Period 3
Retail Sales	+10%	-10%	+10%
Distribution Orders from Retail	+17%	-21%	+32%
Factory Orders from Distributor	+30%	-40%	+48%
Manufacturing Orders from Factory	+45%	-66%	+80%
Factory output	+39%	-60%	+72

, Example of bullwhip effect



http://www.aalhysterforklifts.com.au/uploads/blog/Bullwhip_effect_diagram.png

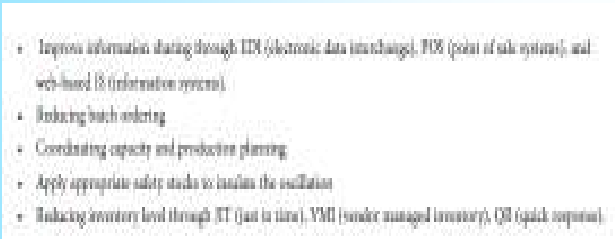
Bullwhip Effect: Causes

- **Behavioral causes**
  - Misperceptions of feedback and time delays
  - Panic ordering reactions after unmet demand
- **Operational causes**
  - Forecast errors
  - Adjustment of inventory control parameters with each demand observation
  - Lead time variability (forecast error during replenishment lead time)
- Trade promotion and forward buying
- Anticipation of shortages

wikipedia

How to alleviate the Bullwhip effect?

establish a demand-driven supply chain which reacts to actual customer orders



- WALMART
  - Each Wal-Mart stores transmit point-of-sale (POS) data from the cash register back to corporate headquarters several times a day
  - demand information is used to queue shipments from the Wal-Mart distribution center to the store and from the supplier to the Wal-Mart distribution center.
  - result is very close visibility of customer demand and inventory movement throughout the supply chain
  - Better information -> better inventory positioning and lower costs throughout the supply chain

Manufacturing: Need for Innovation!

- ***Earlier practice:*** mass production, centred around cost cutting, isolated plant floor from the rest of the enterprise
- ***Challenges:*** requirements for a product's price, quality, delivery performance, customer choice, etc
- ***Reason:*** unexpected changes of competitive market environment, globalization of market, a variety of customers' demands, customer-designed products, and shortened product life cycle
- ***Impact:*** all the manufacturing-related activities such as order, design, planning, manufacturing, workshop floor control, assembly, delivery, maintenance, services, and marketing needed innovation
- ***Action:*** Manufacturers have to work hard to react quickly, responsively and effectively to the market, which is becoming more international, dynamic and customer-driven.

For instance, many European manufacturers design their products in Europe and manufacture them in Far East Asia, and then sell the products at high volume in North America or other continents, as do the American manufacturers.

- manufacturers have to distribute intelligence and decision-making authority as close to the points of delivery, sale and even after-sale service as possible
- to improve response time, companies have to integrate the design and production information with their business partners
- to stay in business, prepare to change

Move to e-manufacturing

http://www.sciencedirect.com/science/article/pii/S1002007108002864

e-Manufacturing: Introduction

- ***information technology*** based manufacturing
- complete electronic (computer systems and networks) integration of all factory components
- users can be from operators to technicians or to engineers to managers
- uses electronically transmitted knowledge to:
  - design products
  - transmit orders
  - procure components
  - drive production machines,
  - and follow it up with remote product maintenance in the field
- links factories to one another, to their supply chains, and to dealers and customers

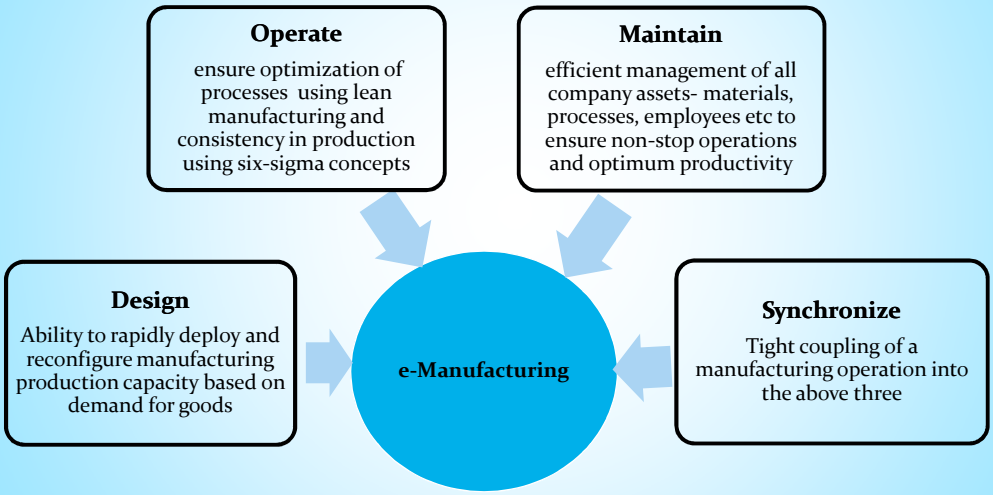
http://buckens.com/secsfrf.htm

e-manufacturing defined....

- devising a technology roadmap for seamless communication between customer, manufacturing operations and suppliers OR
- can mean e-procurement, B2B, B2C, industrial ethernet, e-portals, TCP/IP, XML, collaborative manufacturing, wireless and embedded servers, to Supply Chain Management (SCM)
- is vertical (businesses) and horizontal (supply-chain) integration of systems to ensure to ensure correct dissemination of information throughout the value-chain using:
  - technology like internet to ensure real-time information availability to all decision makers / participants throughout the organization and supply-chain

Practical E-Manufacturing and Supply Chain Management By Gerhard Greeff, Ranjan Ghosha

e-manufacturing Requirements



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e-manufacturing and Supply Chain

ERP/SCM	E-Manufacturing
Financial systems	Waste and downtime tracking
Procurement	Product tracking
Finished goods, raw materials	Production management
Customer service	Control systems integration
Customer orders	Process history
Capacity planning	Real-time quality management
Shipping and logistics	Shop floor metrics
Warehouse management	Decision support
Supply-chain planning	Shop floor user interface
Scheduling	

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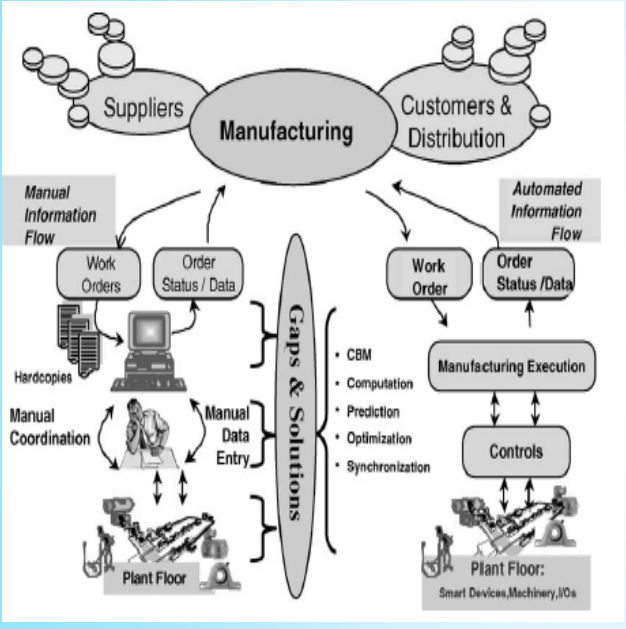
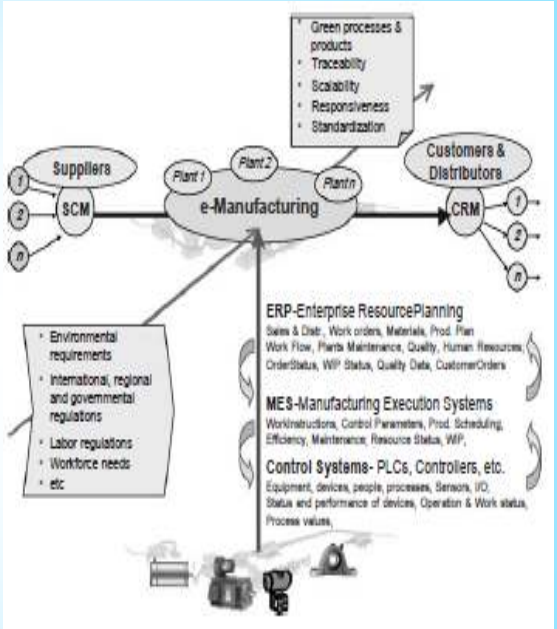
e-Manufacturing: Companies in Action

- maker of snowmobiles in Minnesota, USA linked up with suppliers in Asia who make the moulds for its snowmobile parts
- when an engineer in Minnesota changes a windshield's configuration, the modification is entered automatically in the mould-making equipment halfway around the world
- process that once took weeks has been reduced to minutes

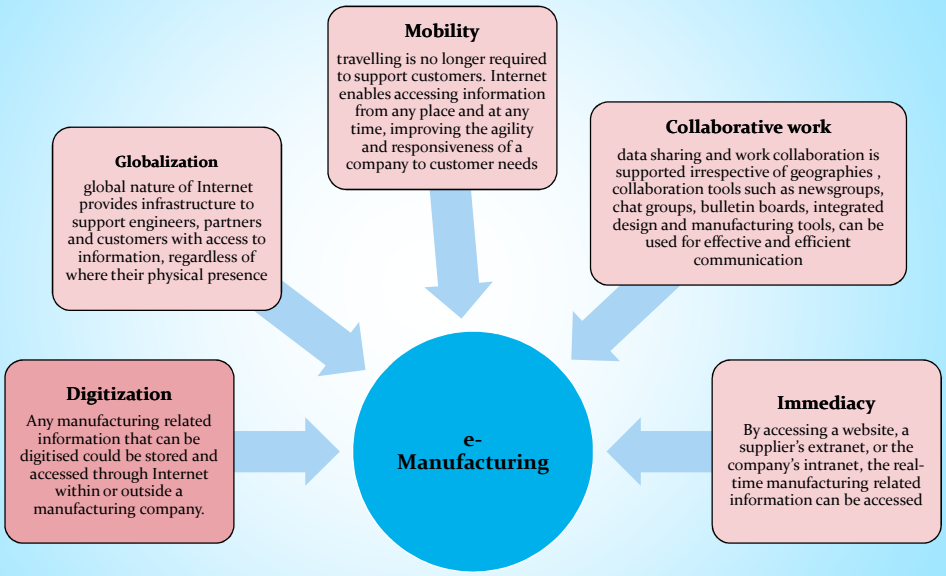
- storage systems division in San Jose, California uses new software to make changes automatically in manufacturing processes at its eight worldwide plants from Mainz, Germany to Shenzhen, China
- changes are stored in a server at each plant; machines at the plants constantly query the servers for changes and automatically incorporate them
- earlier, IT staffers at each plant had to write new computer code for each change—an activity that typically took days or weeks





E-manufacturing—fundamental, tools, and transformation *by Jay lee (2003)*

Characteristics of e-manufacturing



http://www.sciencedirect.com/science/article/pii/S1002007108002864 (2008)

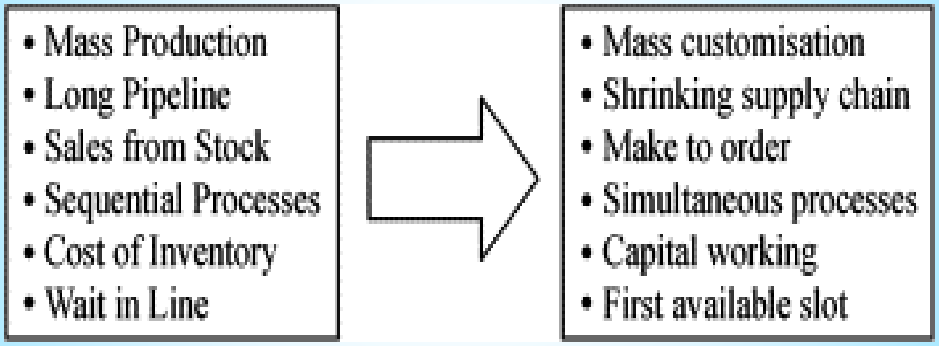
e-manufacturing: Benefits

- opening up opportunities for data intensive activities such as on-line monitoring and diagnostics of machine tools conditions
- knowledge intensive processes including new product development, complex systems modelling and simulation
- supports real-time decision-making and complex problems solving
- improved communications, information and knowledge sharing
- improved efficiency and productivity
- harmonisation and standardisation of procedures
- acquisition of new customers and increased sales
- improved customer service

http://www.cheshirehenbury.com/emanufacturing/emanbenefits.html

http://www.sciencedirect.com/science/article/pii/S1002007108002864 (2008)

Transformation driven by e-manufacturing



Traditional Manufacturing **e-Manufacturing**

http://*www.sciencedirect.com/science/article/pii/S1002007108002864* (2008)

e-Manufacturing: Companies in Action

Background of company
- located near Pittsburgh
- makes complex assembled electrical and electronic products such as electric panels and motor controls for residential and industrial equipment

New System
- allows configure the characteristics of hundreds of complex products with intricate wiring patterns and precise placement of dozens of electrical and electronic components
- minutes after a field sales engineer, distributor or customer completes the customized specifications for a product, machines at two almost identical factories in North Carolina and South Carolina begin automatically producing the product

New System
- program automatically takes care of minute details, such as labels specifying the speed and power of motors and components; after composing the labels, the program directs the nameplate engraver to print the label
- in the past, a technician would type the information for the nameplate, increasing the possibility of errors and slowing the process

Reach of the new system
- two factories also run a total of 17 satellite assembly operations; an additional 14 assembly plants in the United States and Mexico are connected to the new system

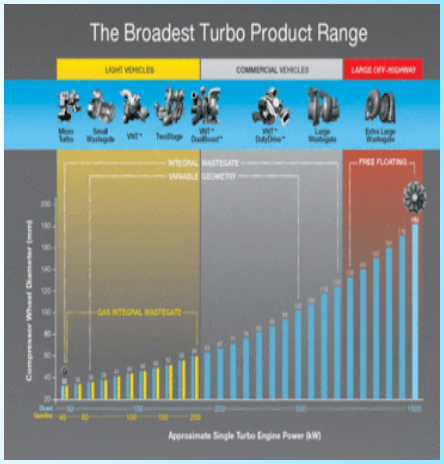
Result
- streamlined internal processes and business practices. For example, Cutler-Hammer has standardized its products and models, slimming down the number of steel enclosure sizes from more than 400 to only 100. In 2001, more than 61,000 orders were processed electronically
- increased sales of some products by 20%, doubling profits, increasing productivity by 35%, and reducing quality costs by 26 %

EATON
Cutler-Hammer

Case Study: Honeywell

- division of Honeywell Transportation Systems
- Garrett Turbochargers Division, is one of the world's largest maker of turbochargers for autos, trucks, and light aircraft
- deals regularly with about 125 key suppliers in the United States,Europe, and Asia
- communicated with these suppliers by EDI (electronic data interchange), fax, and e-mail to get production information to them and solicit firm order commitments from them
- In 2001, to have quicker connections with suppliers, Garrett implemented an Internet based system that allowed suppliers:
  - to view current inventory levels at the turbocharger firm
  - fill consignment levels
  - make firm delivery commitments to orders
  - set up payment procedures

by accessing ***Honeywell Garrett's accounts payable systems.22***



The different types and sizes of Honeywell's turbochargers.

http://en.wikipedia.org/wiki/Honeywell_Turbo_Technologies

e-manufacturing: Challenges

- **Industry Driven**
  - market globalization
  - fast changing technology
  - demanding customer
- **Company Driven**
  - cost efficiency needed for global infrastructure, size and scale
- **Security at every level**
  - network, application, data etc has to be protected
- **Seamless Integration**

Google books: Practical E-Manufacturing and Supply Chain Management

e-manufacturing example

e-Manufacturing from EOS at MTU Aero Engines

(https://www.youtube.com/watch?v=kF_nzOV3MdE)

https://www.youtube.com/watch?v=GYQalZEGx20

(Cookson Precious Metals E-Manufacturing)

selective laser sintering (SLS) is an additive manufacturing technique that uses a laser as the power source to sinter powdered material (typically metal), aiming the laser automatically at points in space defined by a 3D model, binding the material together to create a solid structure