The Manufacturing Grid

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Plan of Talk

- The modern manufacturing context
- E-manufacturing
- Technical, engineering and social aspects
- Related work
- Summary and conclusions
Automotive plant, Kentucky
Evolution of manufacturing

- **Mass Production**
  - Henry Ford, Model T
  - Limited variety
- **Production Optimisation**
  - Mega-factories
  - Product proliferation
  - Long customer lead times
- **Mass Customization**
  - Rapid response, lean manufacturing
  - Products and services tailored to each customer
  - Extended customer relationships
Structure of Mass-Customizing shop floor

Inventory = customer involvement point
Defining the strategies

- MC 1 – Post Delivery (PD)
- MC 2 – Distribute-to-Order (DTO)
- MC 3 – Assemble-to-Order (ATO)
- MC 4 – Fabricate-to-Order (FTO)
- MC 5 – Engineer-to-Order (ETO)
MC 1 – Post Delivery (PD)

Push line

- Customer involvement is after delivery.
- Products are made to stock
- Mass Production
• Customer gets involved prior to the delivery point.
• Products will be distributed on order
• Customer engages during assembly
  
  • Assembly is carried out to order
  • Inventory may contain part-finished goods
MC 4: Fabricate-to-Order (F2O)

• Customer involvement point is fabrication
• Fabrication is done to order
MC 5: Engineer-to-Order (E2O)

- Customer gets involved right at the design stage
- Designed on order
- Inventory of raw materials only
Location of Customer Involvement Point

- E2O: Design
- F2O: Fabrication
- A2O: Assembly
- D2O: Delivery
- PD: Shelf/Showroom
Challenges of Mass Customization

- Providing options the customer is willing to pay for
- Managing the inventory
- Locating the customer involvement point as late as possible
- Add value after the customer involvement point
E-manufacturing

- Most Small and Medium-Sized Enterprises (SMEs) are connected by the Internet
- Inform customers of catalogue of products
- Flexible response from suppliers all along the supply chain
The Hollywood Effect

- Manufacturing organisations form a short-lived alliance to collaborate on design, development and production of a product
- Similar to actors, directors, producers etc collaborating to make a film
Evolution of Supply Chains

- Competition based on price,
  - Arbitrary allocation of orders,
  - Little incentive to invest to improve quality
  - Emphasis on competition

- Keiretsu
  - Competing supply chains,
  - Just in Time delivery by suppliers to the shop floor
  - Shared development and growth
  - Emphasis on collaboration
The Manufacturing Grid

- The electricity grid
  - power available on demand
  - many suppliers
- Computer Grid
  - utilise network of resources
  - user does not know which supplier provides
  - Grid managers control policy and scheduling
Manufacturing Systems and Supply Chain

Raw materials --> Factories --> Distributors --> Shops
The Manufacturing Grid
The issues: technical

- Explode the BOM (Bill of Materials)
- Assemble the components
- Distribute the goods
- What has to be communicated
  - to whom?
  - how often?
  - how are the responses to be negotiated?
Social, networking issues

- Networks involve trust, loose contracts
- Low barriers to entry
- Internet auctions, supplier exchange networks have not worked as well as hoped
- What can be learned from eBay?
- Role of moderators, brokers, managers
Engineering issues

- What infrastructure is required?
- How can the flow of information and goods be done
  - cheaply
  - reliably
  - quickly
  - efficiently
  - predictably
- Combining unscheduled and scheduled manufacture
Lessons from Cabdyn

- Design of network structure
- Structure dynamics
  - forming, strengthening and breaking links
- Dynamics of communication
- As network size and structure grow, what changes to communication dynamics can we anticipate?