Modern manufacturing methods and systems

Production scheduling and production logistics:

- Allocate all resources/tasks in the correct order (efficient production)
- Save time/money/energy cost by increasing productivity
- "Rate of output per unit input"
- How efficient a person works
- How much they produce in a given time
- Usually done on a IT system to make paperwork easier to retrieve

IT system in production scheduling/logistics:

Advantages	*Disadvantages*
• Flexible and easy to adapt • Monitor progress of work • Ease of access to information • Limit access • Increased productivity • Decrease time to market • Improves worker moral (bonuses) • Workers are given a statement of what should be done and when	• Need a robust IT system • Corrupted data • Software updates • Training (reluctant to change) • Change over period can be problematic

Computer systems:

- Planning/control software is used to organise complex manufacturing processes
- Spreadsheets/charts always available, giving instant overview of factory schedules and operations
- Barcodes/radio frequencies tags facilitate the reliable transfer of component and stock information by scanning, helps to reduce waste and improve the speed of response to changes in demand

Artificial intelligence:

- A piece of software that can learn and adapt (voice recognition)
- Simulations and tests can be performed
- A "co-worker" (suggestions and ideas)
- Store/retrieve massive amounts of data quickly
- Ability to identify mistakes/problems and fix these issues

Robotics in production:

Robots on fully-automated production and assembly lines/cells:

- In cells, manufacturing cells combine CNC machines (lathes, milling machines, drills, grinders) in a group
- The cell is programmed to carry out a sequence of operations to make parts (car engine)
- Automatic guided vehicles (AGVs) transport materials/parts to and from buffer zones
- Robots with 6 axes (direction of movement) load and unload machines
- These devices are programmed along with the CNC machines they are servicing

Advantages	*Disadvantages*
• Able to repeat repetitive tasks • Can be used in hazardous locations • More productive than humans (no breaks) • Cost effective • Removes human error • Can be reprogrammed	• Expensive set up cost • Not as flexible as humans • Expensive to maintain

Uses: Assembly lines for products e.g. cars

Applications: Spot welding, spray painting, pop riveting, routing, milling

Material handling systems:

Automated guided vehicles (AGVs):

- Used to move tooling/parts
- Controlled by a computer system

*AGV's are GPS guided/laser guided/line/guided/radio wire guided

How they work:

- Route determined by computer
- Lasers pick up the route
- Information fed back to microprocessors
- Microprocessors on vehicle follow laser route
- Continuous adjustments made by microprocessors

Uses: To move materials/tooling/parts

Examples of AGVs: Towing vehicles, pallet trucks, fork lift trucks, assembly line vehicles

Automated storage and retrieval systems (ASRS):

- Collects stock materials in racking system
- Selects component that is needed and places it on AGVs

Advantages	*Disadvantages*
• Parts are retrieved for the precise time needed • Can run 24/7 • Reduced employment costs • Reduced error/damage of goods • Improved safety regrading heights	• High set up costs/repair costs • Needs a uniform system of unitising • Lack of flexibility • Puts people out of work • Faulty parts may go undetected

Uses: To move materials/tooling/parts

Flexible manufacturing systems (FMS):

- Several machines are linked together controlled by a central computer
- CNC/robotics/ASRS/AGVs are used
- High flexibility
- Routing of material through a system

Advantages	*Disadvantages*
• Fast response to market change/batch size can be altered quickly/shorter lead times/quicker to market/reduced down time • Increased market share/higher profit/competitive edge • Manufacturers can coordinate with their suppliers • Reduces storage space • Products can be customized • FMS systems are able to check the quality of their own work • Machines are flexible/not tied to producing a single product • Rerouting workflow to maximise efficiency • Low labour costs	• High initial set up • Potential reduction of output due to large batches • Staff would need training/retraining • Need skilled/flexible technicians • Planning is needed • Hard to predict the market

Flexible manufacturing over inflexible automated machinery:

Advantages	*Disadvantages*
• Production can be quickly altered- allowing fast response to market changes • Small batches can me produced- reducing capital tied up in stock • Less reject components- FMS are able to check the quality of their work • Large set up cost- would be offset by minimal alteration costs when production is changed	• Production rate could be reduced- CNC machines are slower than automated machinery • Staff would need retraining- as different skills needed to operate new equipment • Downtime needed to install new systems- no products being produced during this time (financial problems)

Modular/cell production systems:

Functional cells:

- Specific function
- One purpose
- Not flexible
- Higher levels of waste

Group technology cells:

- Series of operations for several different product lines
- Works well within a lean manufacturing environment
- Machines are more flexible/not just one job

Product focused cells:

- Product focused
- Manufacture one product through a series of operations

- Perfect for small product range with high volume demand
- Ideal for lean manufacturing

Lean manufacturing using just-in-time (JIT) systems:

- Lean manufacturing is a waste reducing method within a manufacturing system
- It reduces waste in energy/transport/time/staff/materials processes/systems
- JIT is a key feature of lean manufacturing
- Lean manufacturing is very efficient
- Kaizen- continuous improvement for production processes (small changes=small improvements)

Lean manufacturing:

Advantages	*Disadvantages*
• No wasted storage, products dispatched when needed • No wasted time, production delays are eliminated • No wasted energy, movement of materials is minimized • No wasted materials, only amount needed ordered • Minimized faulty products, rigorous quality assurance systems in place • No wasted labour, work tasks are carefully planned • No wasted equipment, machinery does not stand idle	• Reliant on supplier being on time with orders • High QA is expensive • High maintenance costs • If one machine breaks system stops • High set up cost • Unemployment due to high automation • Need a robust IT system • No room for error • Staff illness can cause delays

Just-in-time:

Advantages	*Disadvantages*
• Parts are ordered when needed/automatically • Less money tied up in stock • Less storage space needed, cost of warehouse reduced • High returns for company • Reduces the movement of materials, environmental factor • Lean manufacturing reduces production times • Can react to market trends • Higher levels of quality assurance • Increased job satisfaction • Reduces labour costs	• Reliant on supplier being on time with orders • High QA is expensive • High maintenance costs • If one machine breaks system stops • High set up cost • Unemployment due to high automation • Need a robust IT system • No room for error • Staff illness can cause delays • Early deliveries can't be accepted as no storage space

Standardised parts, bough-in components:

Standardised parts:

- Parts made to a common, interchangeable standard (nuts and bolts)

Advantages	*Disadvantages*
• Readily available • Specification data is already known • Designs decisions are simplified • Consumer can source replacements easily • Manufacturer does not need to stockpile	• Depending on manufacturer to supply a product can be less reliable e.g production line delayed • Can be more expensive than making yourself • More storage space may be required • Longer time required for ordering and supplying

• Time saved by buying in parts, not designing and making them	• No control over making/quality

Applications: Castors, bolts, washers, hinges, shelf brackets

Bough-it components:

- Parts that are sourced from external suppliers

*Same advantages and disadvantages standardised parts

Quick response manufacturing (QRM):

- Quick Response Manufacturing (QRM) is a companywide strategy to cut lead times in all phases of manufacturing and office operations
- It can bring your products to the market more quickly and help you compete in a rapidly changing manufacturing arena
- It will increase profitability by reducing cost, enhance delivery performance and improve quality
- Stock levels constantly revaluated (JIT)
- Products/materials only bought when needed

Advantages	*Disadvantages*
• Reduces the time to market/lead time • Keep up with trends • Reduces retooling cost • Increased market share • Improved cash flow • Storage costs reduced • Highly automated, reduced labour costs • Reduced human error/waste • Allows flexibility	• Large variation in demand will cause problems if the manufacturer can't react to the high production of volume quick enough • Reluctant to change • Need a robust IT system • Highly dependent on suppliers to react to demand

• Business increases reputation	

Data integration:

Product data management (PDM):

- Use of software or other tools to track and control data related to a particular product
- Data tracked usually involves the technical specifications of the product, specifications for manufacture and development, and the types of materials that will be required to produce good

Enterprise resource planning (ERP) systems:

- Intergrade all departments and data across a company onto one single computer
- Unified data base

Advantages	*Disadvantages*
• ERP improves the way a company takes a customer's order • Quicker response to orders • Increased customer satisfaction • Improves communication within business • Customer orders can easily be tracked	• Robust IT system needed • Expensive to install • System failure effects all areas of the business

Concurrent manufacturing:

- Simultaneously completing design and manufacturing stages of production
- Systematic approach to the integration of design, manufacture, and related processes
- All life cycle stages of the product are considered simultaneously

Advantages	*Disadvantages*
• Produces 'right-first-time' product • Reduces waste • Reduces product development times • Reduced lead times • Enables faster release of new products • High quality product	• All departments must work together which can cause arguments/stand offs • No room for mistake • Robust IT system • High QA/QC can be expensive • Reluctant to change to new ways