UNIT 50: ADVANCED MANUFACTURING TECHNOLOGY

Unit code : **R/615/1518**
Unit level : **5**
Credit value : **15**

Tutor : Mr PM Subramanian

CONTENT

01 ADVANCED MANUFACTURING PROCESSES (AMT) & APPLICATIONS

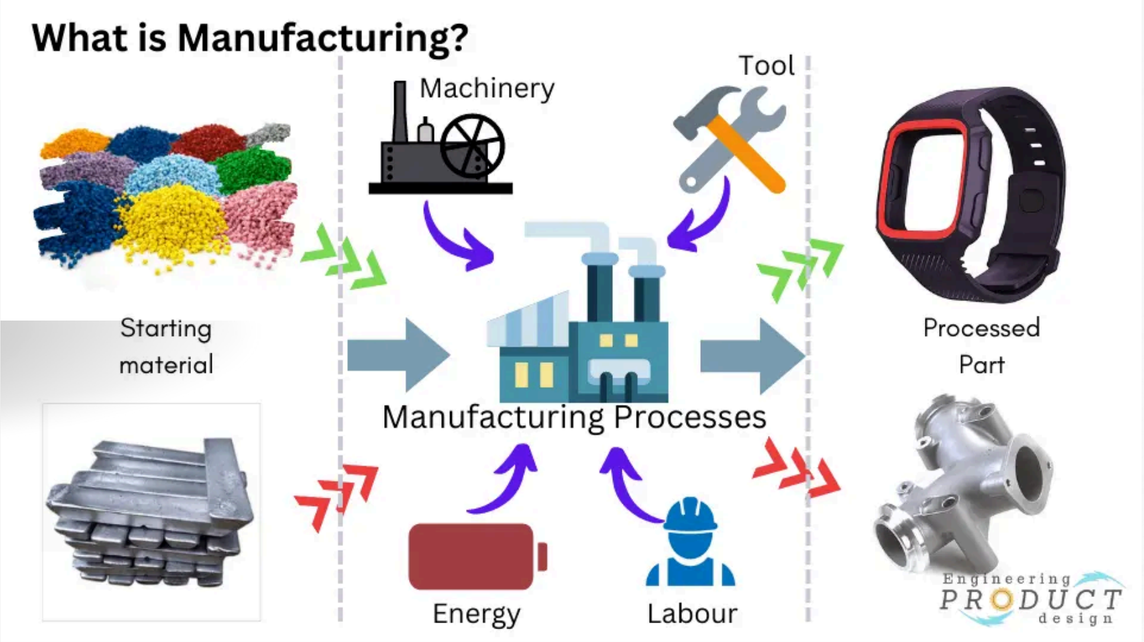
02 ADAPTIVENESS OF ADVANCED MANUFACTURING PROCESSES

03 INTRODUCING AMT - EXISTING MANUFACTURED PRODUCT AND PROCESS

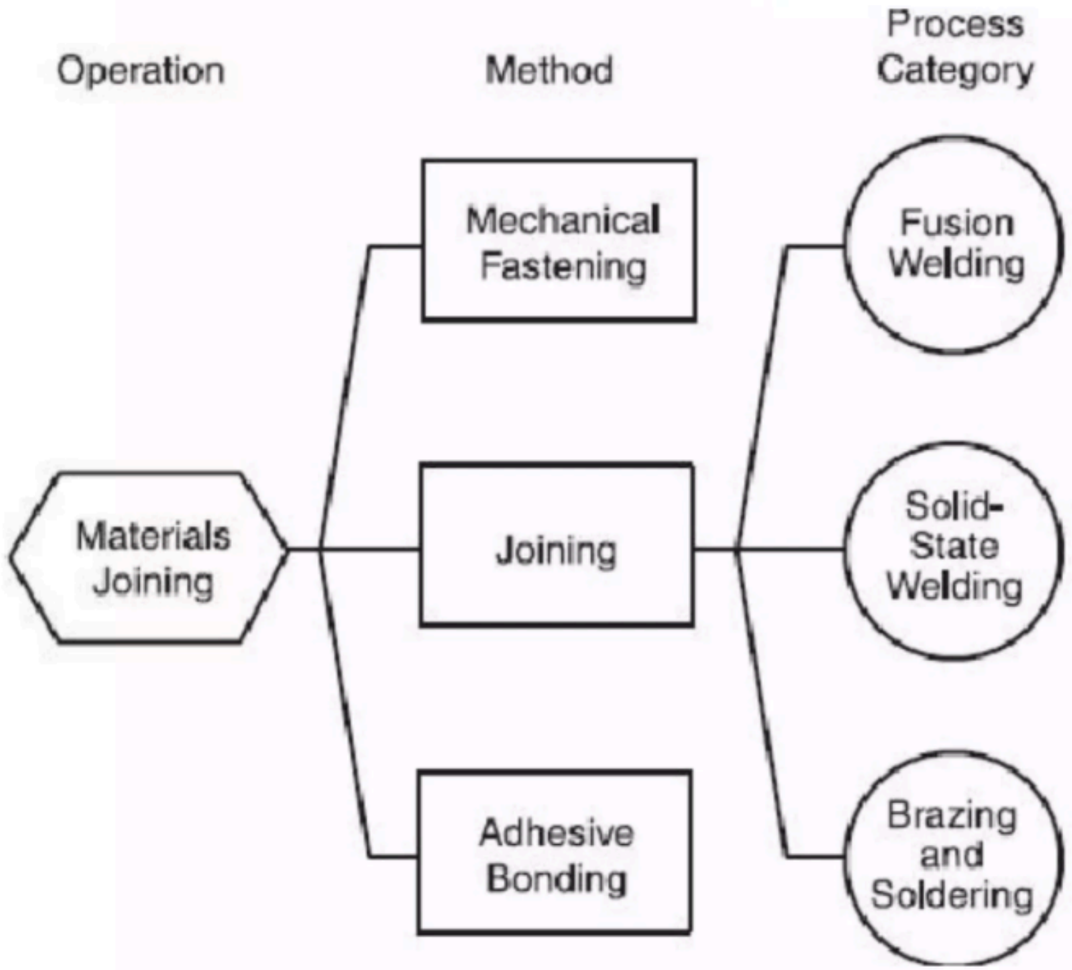
04 INDUSTRIAL REVOLUTION

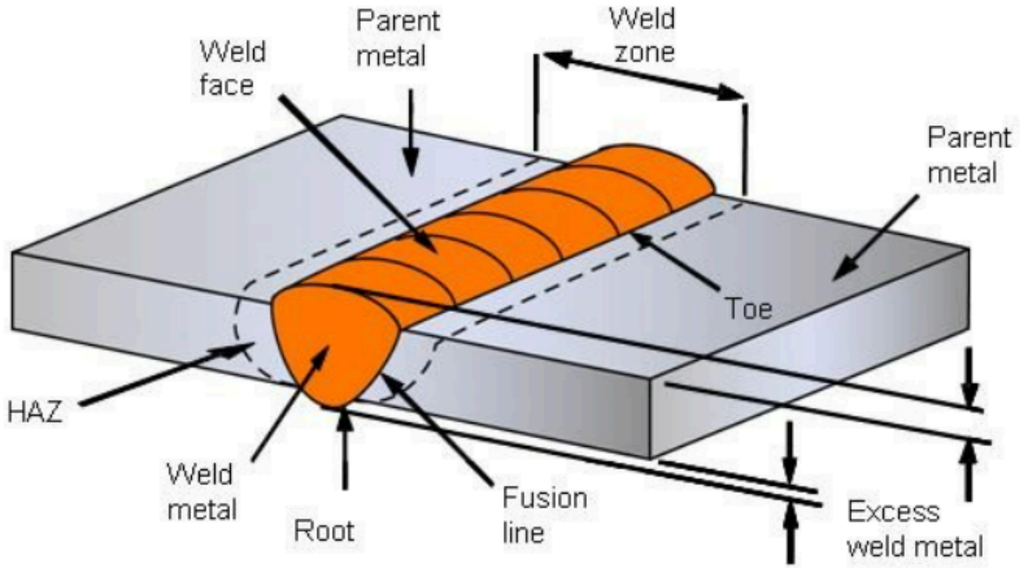
TRADITIONAL MANUFACTURING PROCESSES

- Joining and Soldering
- Mixing
- Final assembly
- Packaging,
- Material Handling
- Quality Control/Inspection



Overview on Joining Processes





Butt weld

Permanent joining process

- Adhesive bonding -

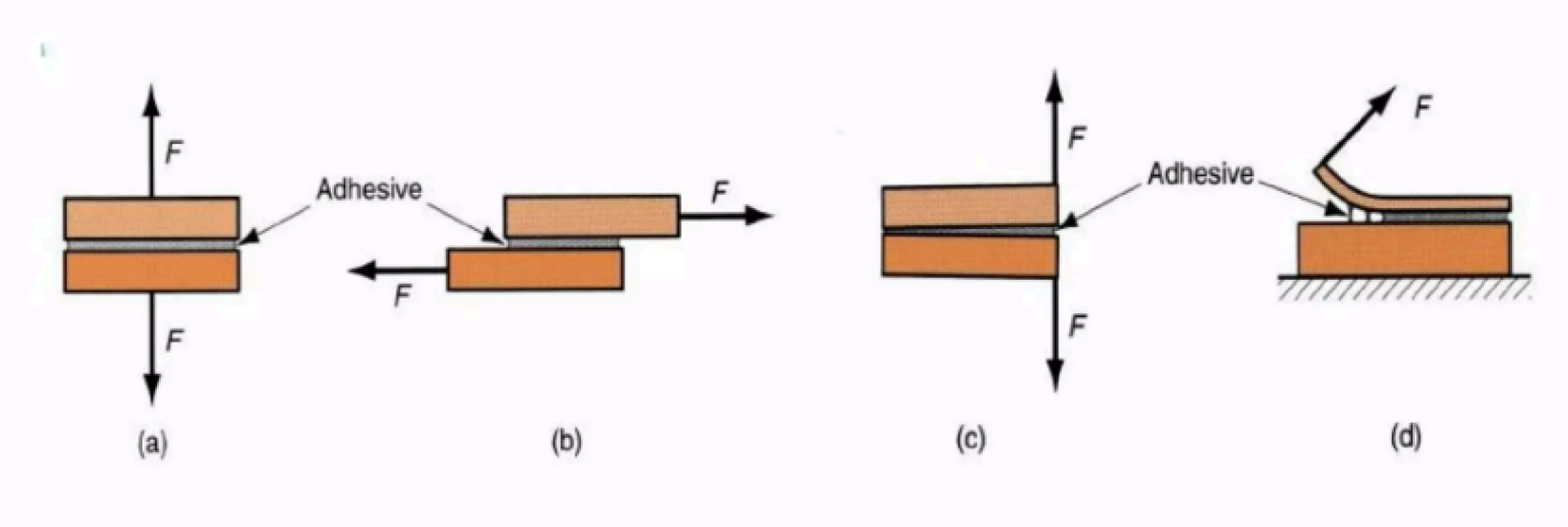
Filler Metal

similar and disimilar metals

smooth bond, glue, epoxy, plastic agents that bond via solvent evaporation or curing via heat, time, or pressure

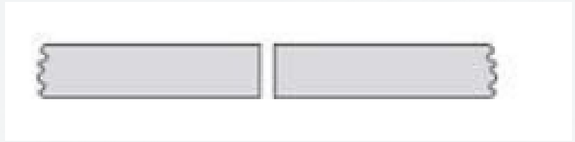
strong in tension & Shear

Weak in peeling

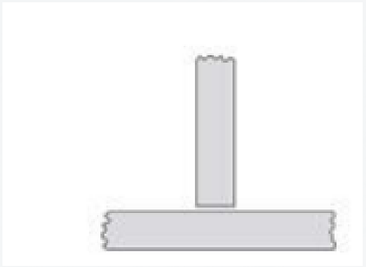


Permanent joining process

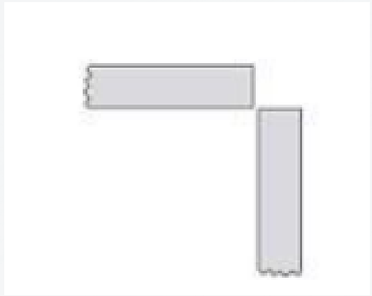
welding -
high heat process,melts,filler material,Pressure ,shielding gas



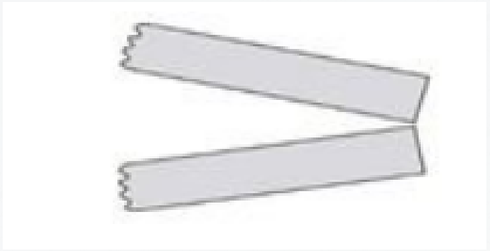
Butt Joint



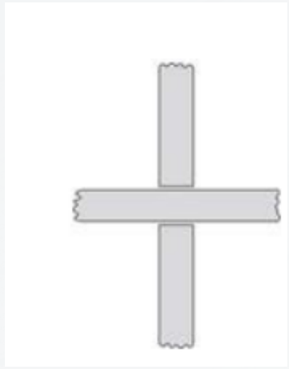
T Joint



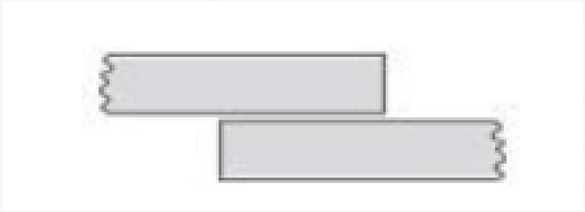
Corner Joint



Edge Joint



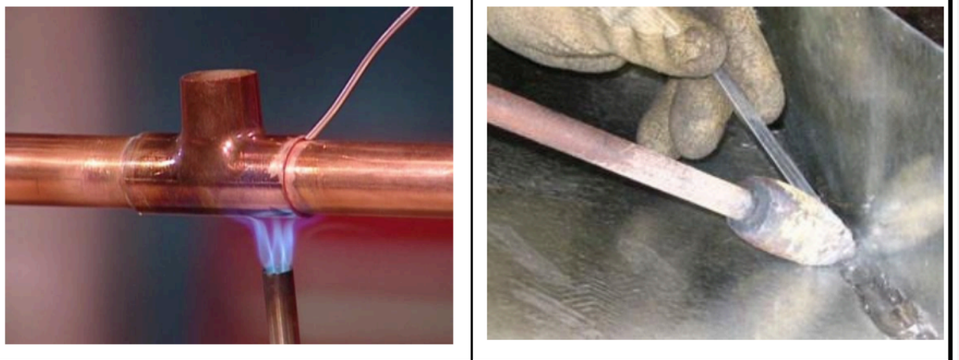
Cruciform Joint



Lap Joint

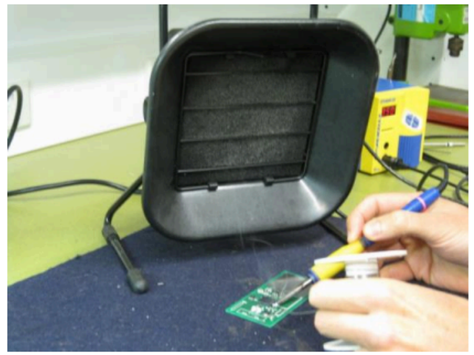
Permanent joining process

- soldering - mechanical or electrical bond.
- low MP metal alloy (solder) which is melted
- electrical components and wiring

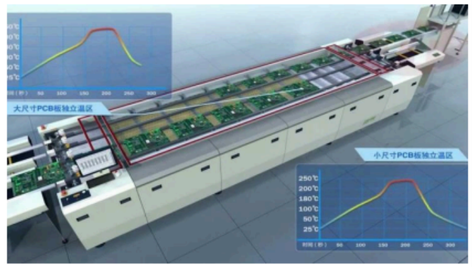


Soldering copper pipe

Sheet metal fabrication



Hand soldering components on PCB



Industrial oven for surface mount

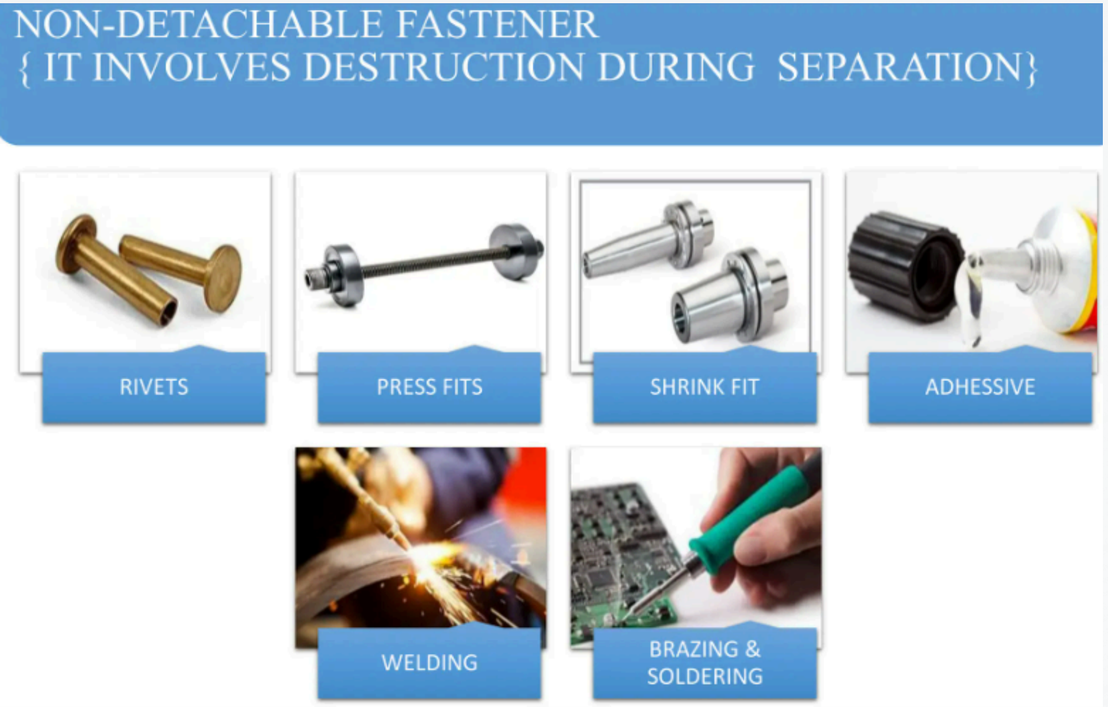
Permanent joining process

- Brazing
  - without melting the base materials
  - join dissimilar metals
  - cleaner joints
  - more energy-efficient
  - higher temperatures,stronger joints , than soldering
  - mechanical applications



Mechanical fastening

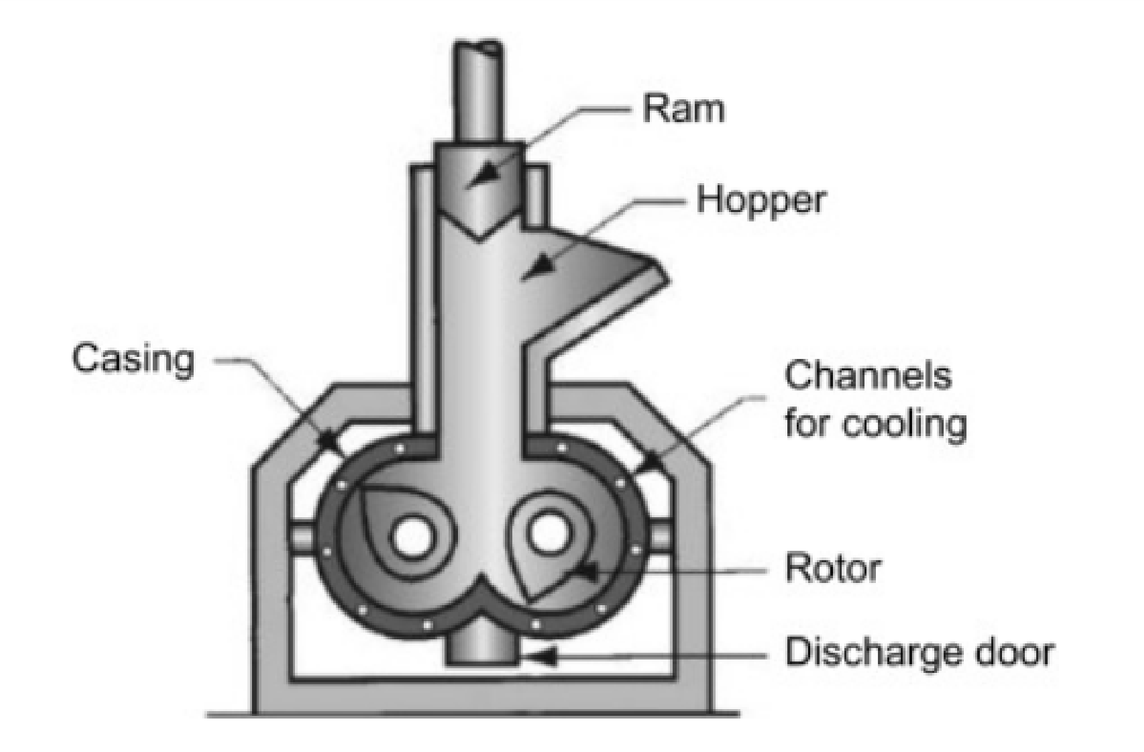
- disassembled.
- metals, plastics, and other materials.
- Permanent -rivets, press fitting, and expansion fits
- non permanent industrial fasteners,Threaded fastening screws, bolts,





Mixing

- combines two or more components to create a homogeneous result
- transfer of heat, matter, quantity, and movement between components
- uniform concentration



Final Assembly

- individual parts are put together to create the final product
- Final Assembly Schedule (FAS)
- Final Assembly, Testing, and Packaging (FATP)
- Automotive final assembly
- Components Identification and Verification
- Mechanical Assembly and Integration
- Electrical Wiring and Connection
- Testing and Quality Assurance

Future Trends

- Automation and Robotics
- Internet of Things (IoT) Integration
- Additive Manufacturing

Packaging

- Process of designing, producing, and evaluating the materials used to protect and contain products for storage, transport, sale, and use
- Protection,Identification,Cost, Ease of manufacture
- cardboard, heavy-duty plastic
- **Primary packaging -** direct contact with the products,protect them and maintain their ideal characteristics
- **Secondary packaging -** create unit loads grouping various types of primary packaging
- **Tertiary packaging -** outer layer, the final and largest piece of packaging,groupings of products in primary and secondary packaging.



Material Handling

- process of moving, storing, protecting, and controlling materials and products throughout the manufacturing, distribution, consumption, and disposal process.

- Manual Handling
- Semi-automatic or automatic handling
- Automated material handling



Hand Pallet



Drum Handler



Hand Stacker



Lifting Scissors



Forklift



Crane

TYPES OF MATERIAL HANDLING EQUIPMENT

storage and handling

- Not Used for Next Stage

- **Pallet racks**
- **Shelves, bins and drawers:**
- **Mezzanines:**
- **Stacking frames:**

bulk material

- stores, controls and transports loose form materials in large quantities

- **Conveyor belts:**
- **Stackers:**
- **Reclaimers:**
- **Bucket elevators:**
- **Hoppers:**

industrial trucks and engineered systems.

- transport goods and materials within your warehouse

- **Forklifts:**
- **Hand trucks:**
- **Pallet Trucks:**
- **Sideloaders:**
- **Order pickers:**

Engineered Systems

- technology supported by computers and robots to store and transport goods

- **Autonomous mobile robots**
- **Automated storage and retrieval systems (AS/RS):**
- **Automated guided vehicles (AGVs):**

Quality Control/Inspection

- a process that involves examining, measuring, and testing products to ensure they meet quality standards
- products or services
- Pre-production, During production, Pre-shipment, Container loading and unloading, and Final quality check.
- Reducing defects
- Improving customer trust
- Maintaining consistency
- Identifying areas for improvement

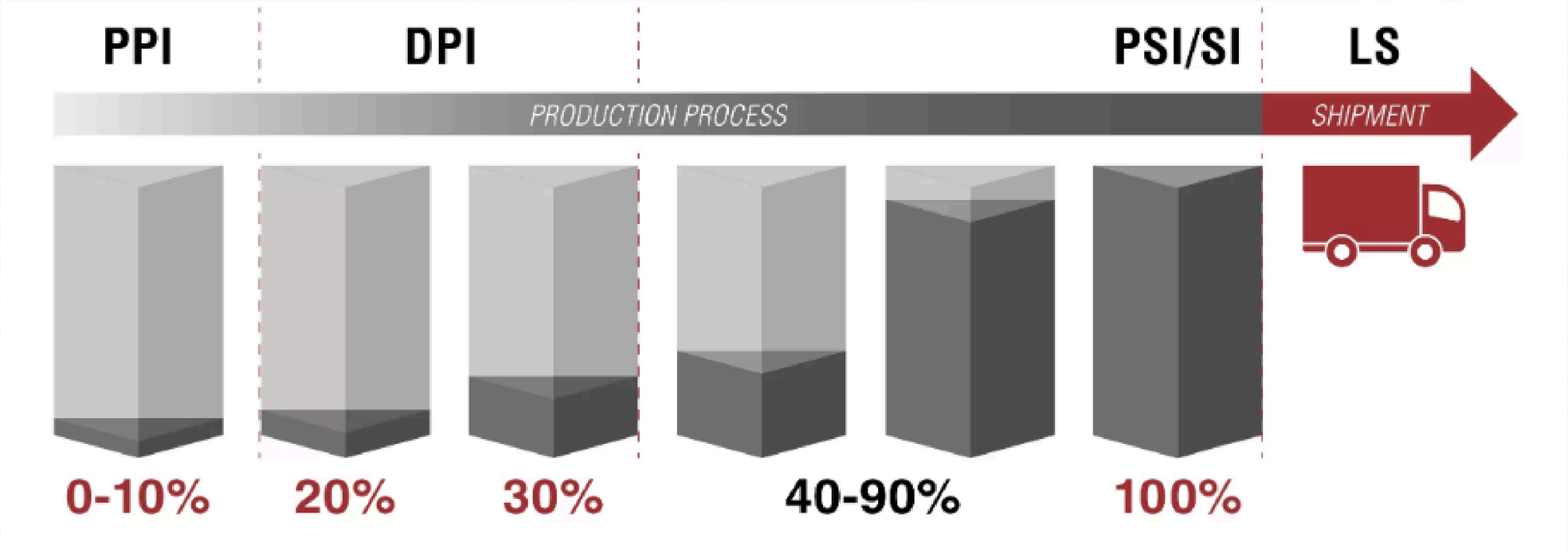
ISO 9000:



Quality Control/Inspection

Quality assurance definition: verifying that products or services meet specific specifications and requirements.

Quality compliance definition: t a product meets the standards and rules specified by an organization or authoritative body.



Quality Control/Inspection

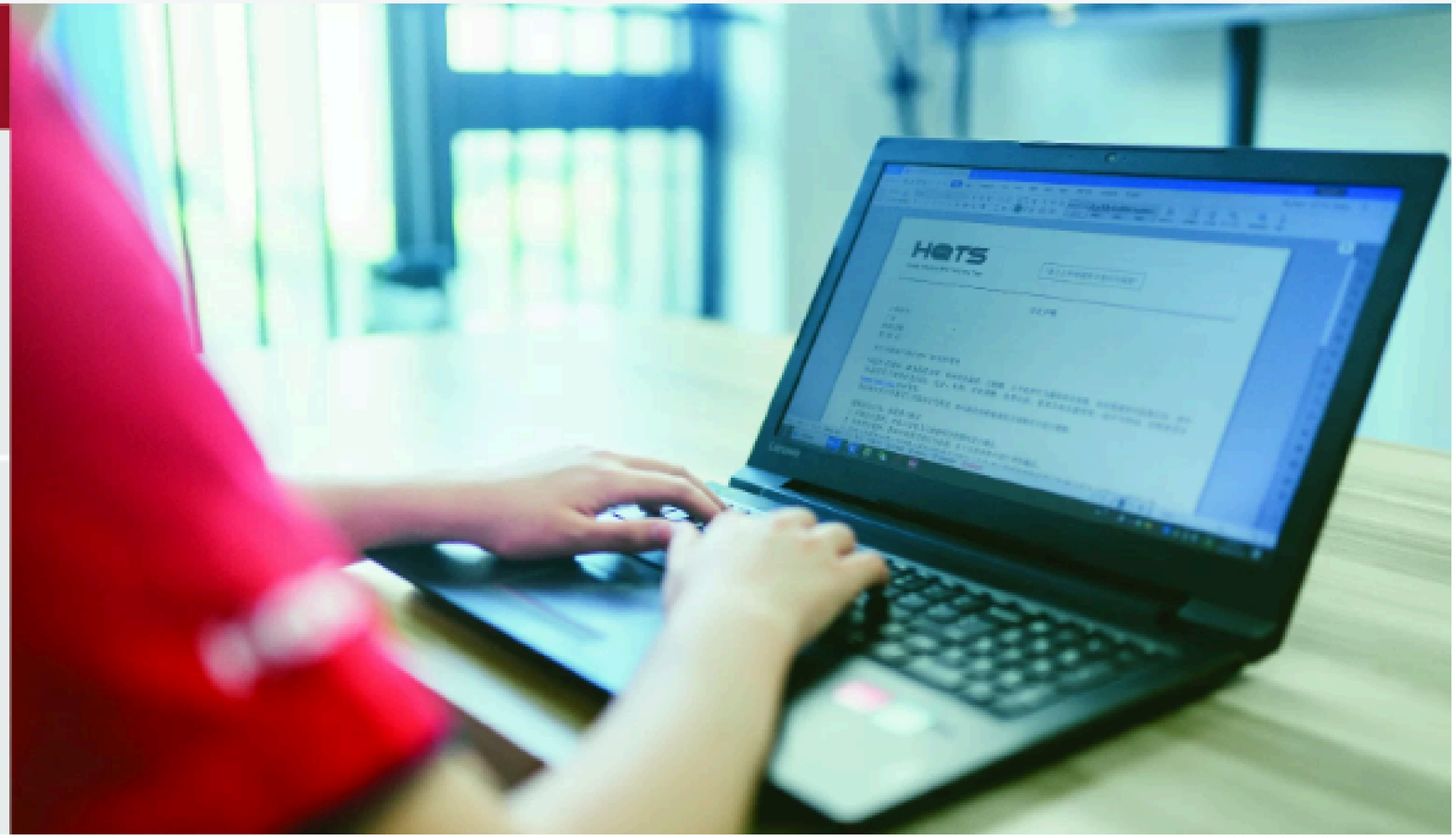
Pre-Production Inspection (PPI)

Conducted before the production process begins

Helps to assess the quantity and quality of the raw materials and components and whether they conform to the relevant product specifications.

The PPI includes:

- ✓ Factory's production lines & capability
- ✓ Factory's facilities & equipment
- ✓ Raw materials, main components & accessories
- ✓ Semi-finished samples
- ✓ Some finished samples



Quality Control/Inspection

During production inspection (DPI)

Conducted while production is underway.

Useful for products that are in continuous production that have strict requirements and when quality issues have been found prior to manufacturing during an earlier PPI.

The DPI includes:

- ✓ The production status during the manufacturing process
- ✓ Production line evaluation and timeline verification
- ✓ Random sampling of semi-finished and finished products
- ✓ Verify package and packaging material details
- ✓ Overall assessment and recommendations



Quality Control/Inspection

Pre-shipment inspection (PSI)

Conducted on finished products when at least 80% of the order has been packed for shipping.

Random samples are selected and inspected for defects against the relevant standards and procedures.

The PSI includes:

- ✓ Quantity verification
- ✓ Style and color
- ✓ Functions and safety
- ✓ Workmanship
- ✓ Size specification (if required)
- ✓ Package details
- ✓ Shipping marks



Quality Control/Inspection

Loading supervision (LS)

Container loading and unloading inspections ensure your products are loaded and unloaded correctly. The whole process will be supervised to guarantee product's safe arrival to their final destination. The procedure:

- Record the weather/arrival time of container/container No.
- Check the inner and outer condition of container
- Check the quantity of goods loaded and record the condition of outer packaging (master cartons/pallets)
- Randomly select and open sample cartons to verify compliance with customer's specifications
- Supervise the loading process to minimize breakage and maximize space utilization
- Seal the container
- Record the seal Nos. and departure time of containers



Quality Control/Inspection

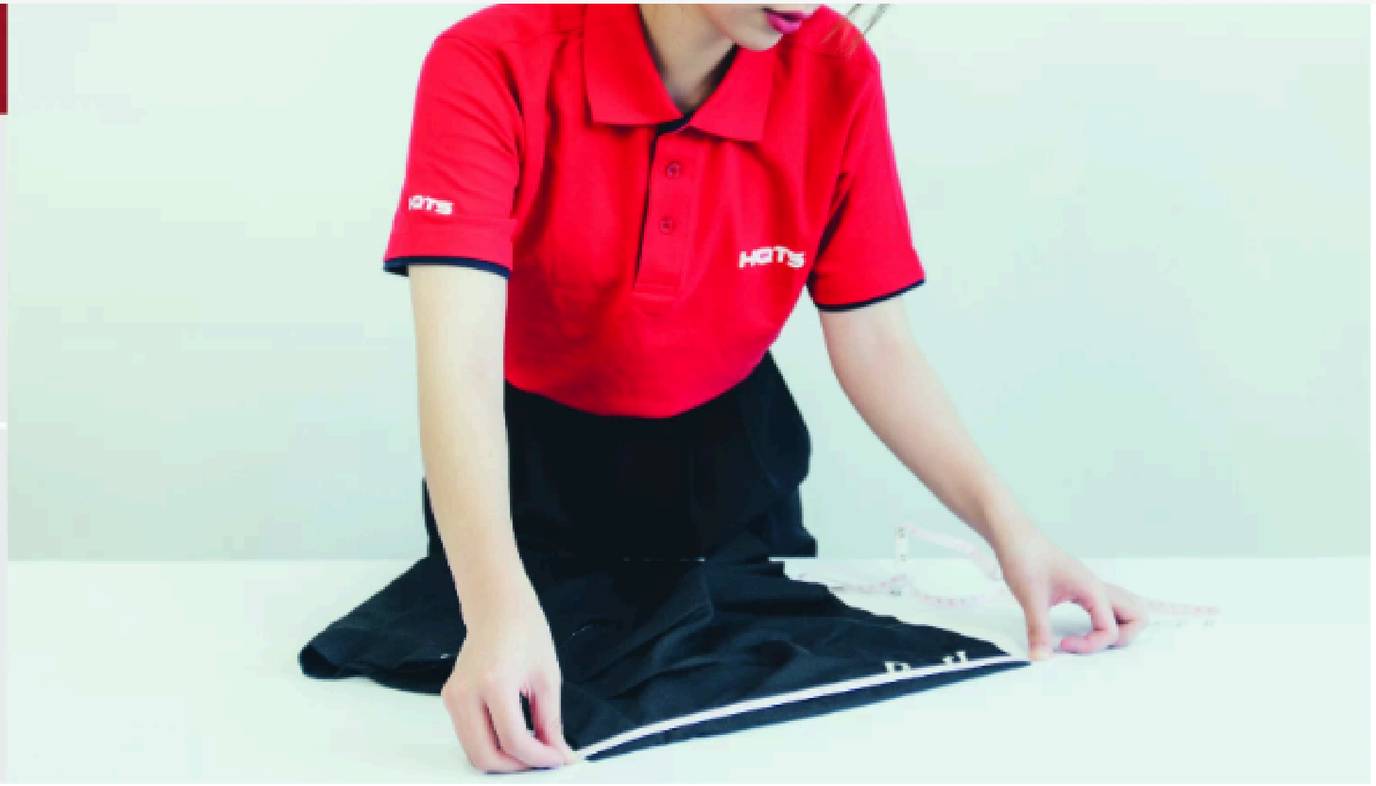
Piece by Piece Inspection

Conducted in the circumstance where the goods require particular attention to ensure compliance to specification or when the goods are high-value

Help to check each and every item to evaluate a range of variables; can be carried out either before or after the packaging inspection

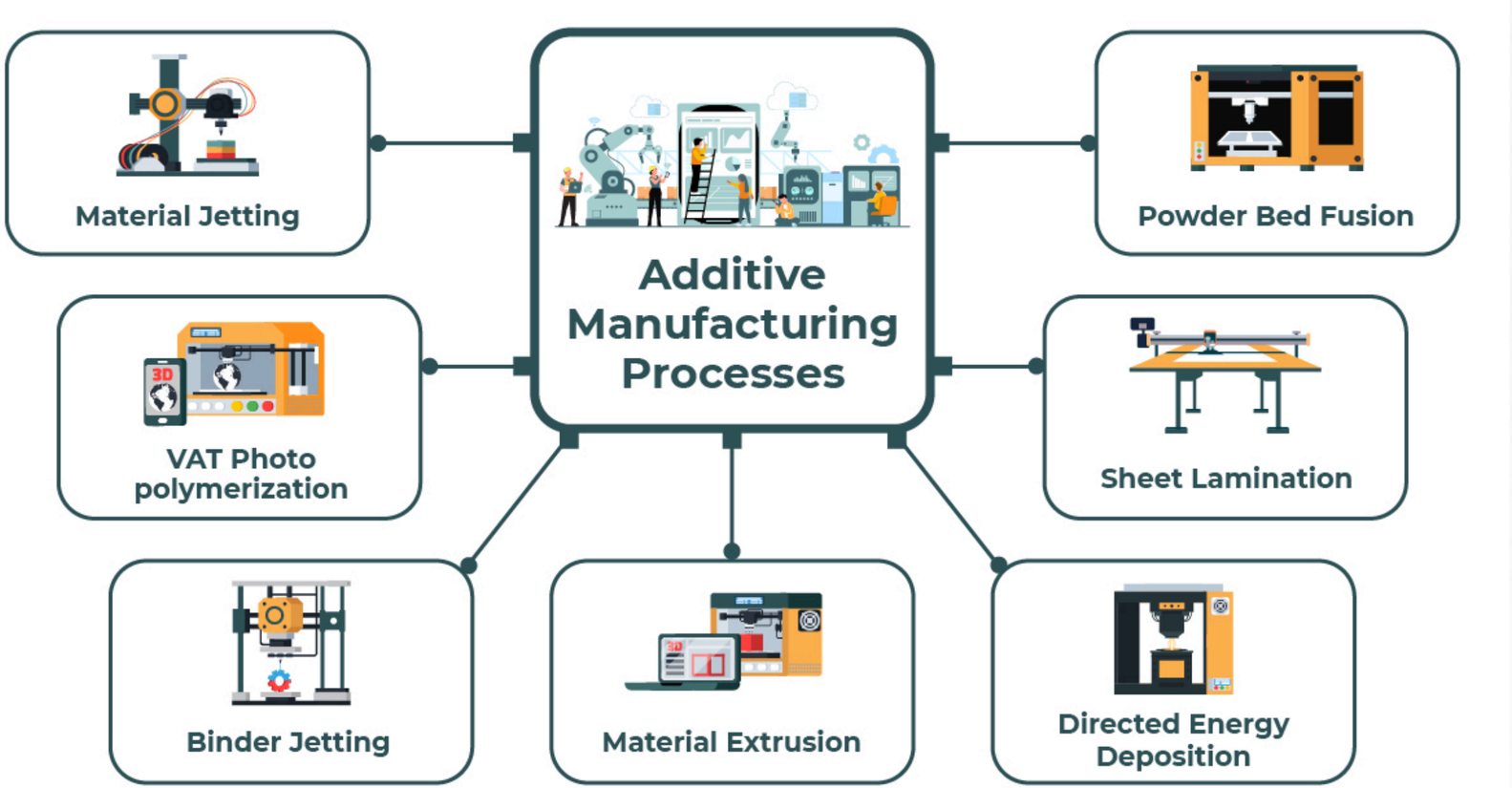
The Piece by Piece includes:

- ✓ General appearance
- ✓ Workmanship
- ✓ Function
- ✓ Safety.



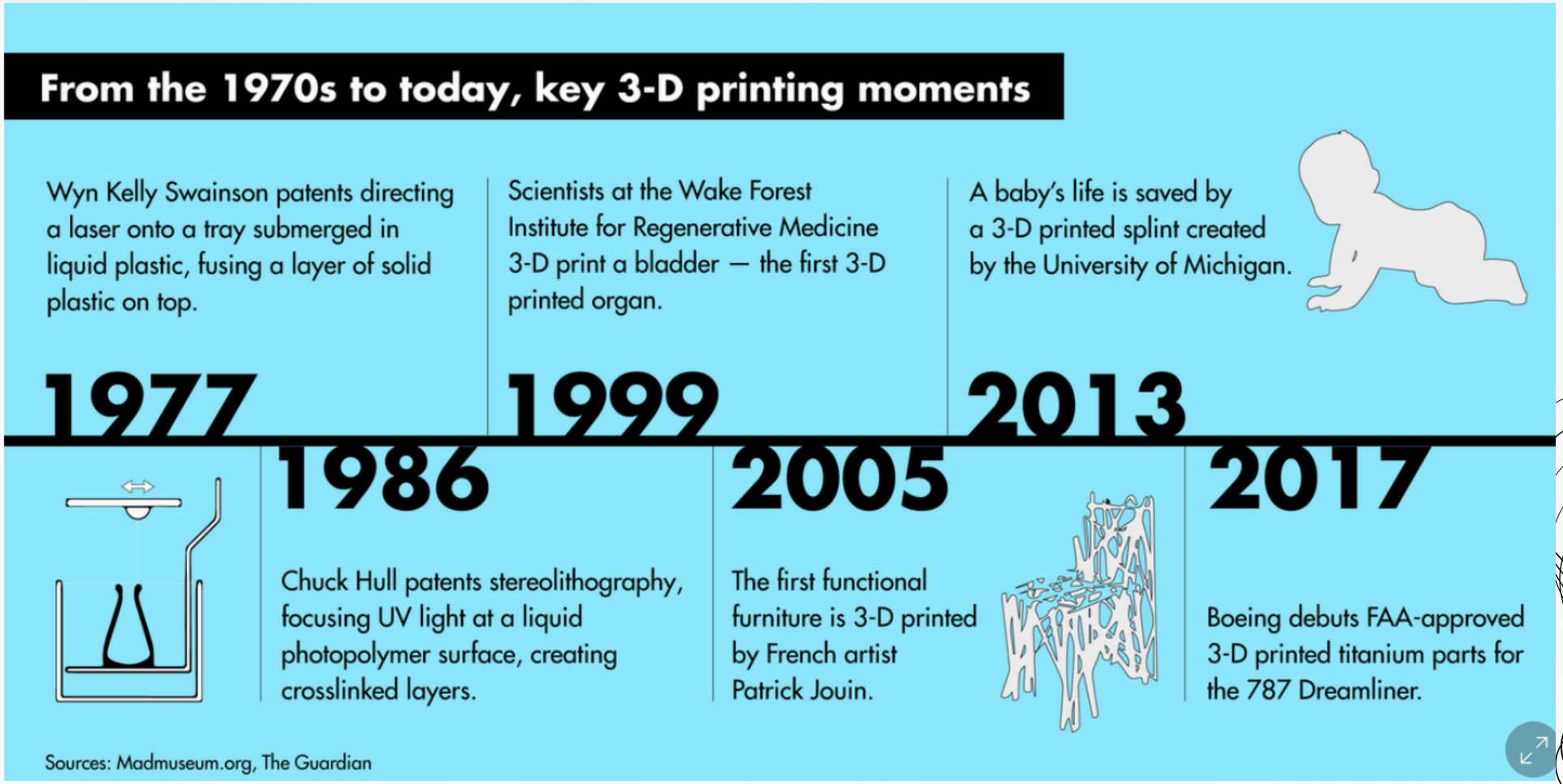
Advanced manufacturing processes:
Additive manufacturing technology

- fabricate a physical object from 3D digital model,
- laying down and bonding a large number of successive thin layers of materials.
- deposit material, layer upon layer, in precise geometric patterns to create tangible objects.
- 3D printing or rapid prototyping
- opposite of subtractive manufacturing

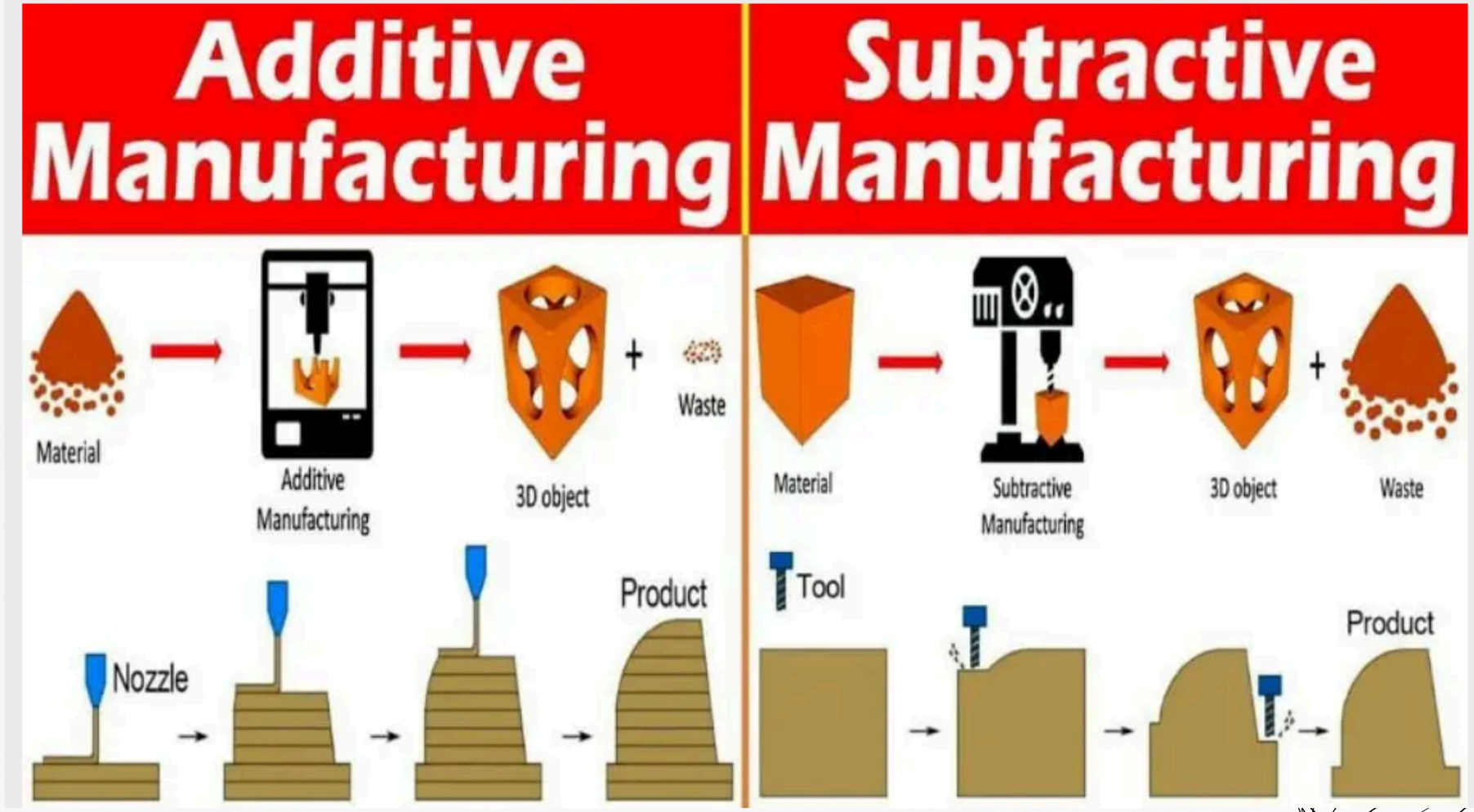


Advanced manufacturing processes:
Additive manufacturing technology

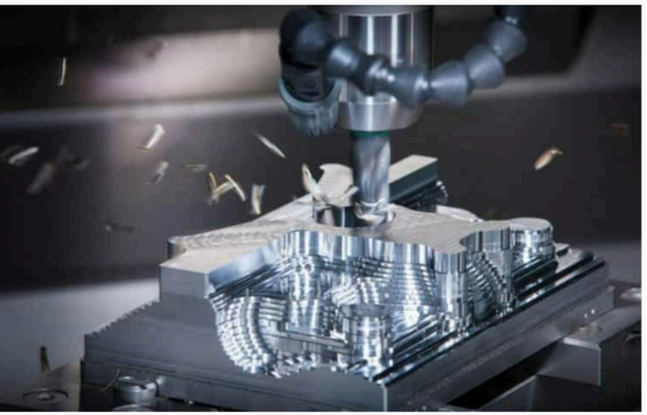
- prototypes in the 1980s
- rapid prototyping -scale model of the final object- without set up process & cost
- Boeing and General Electric



Advanced manufacturing processes:
Additive manufacturing technology



What's Subtractive Manufacturing?



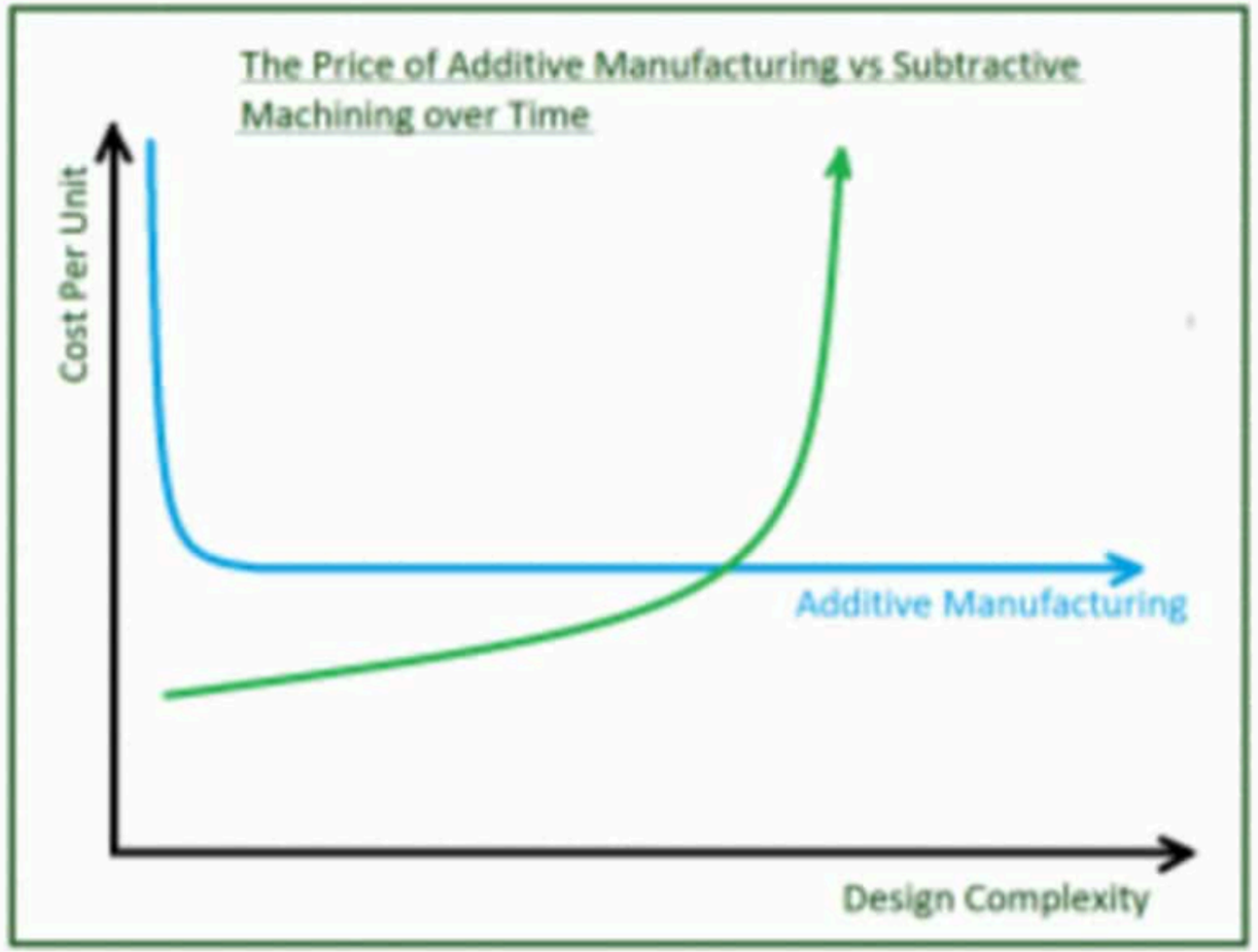
Advanced manufacturing processes:
Additive manufacturing technology

Comparison Table Between Additive Manufacturing Vs Subtractive Manufacturing

	Additive Manufacturing	Subtractive Manufacturing
Material Options	Works with a narrow range of materials, mostly plastic, plastic derivatives, biochemical, resin, and some metals	It uses a wider range of materials, including; stone, glass, wood, foam, metals, and plastics
Achievable Complexity	Better than 5-axis CNC machining in the development of complex and intricate designs	Ideal for use with simple geometry
Accuracy	The products produced using this process are less accurate than the traditional process. The most accurate additive manufacturing process has a tolerance level of 0.100mm	It produces products with more dimensional accuracy. With Tolerance levels as tight as 0.025mm
Properties Of Finished Parts	Parts produced using this technique might have structural weaknesses. The reason is that the production occurs through layering, and this compromises some properties	Parts produced have excellent heat resistance and are structurally sound
Surface Finish Choices	Finishing is an important aspect of parts produced using this technique	Finishing is not compulsory for parts produced using this method
Speed	Faster and less costly when the prototype and batch production are small	Faster and less costly when the prototype has large parts or production batches are large

Advanced manufacturing processes:
Additive manufacturing technology

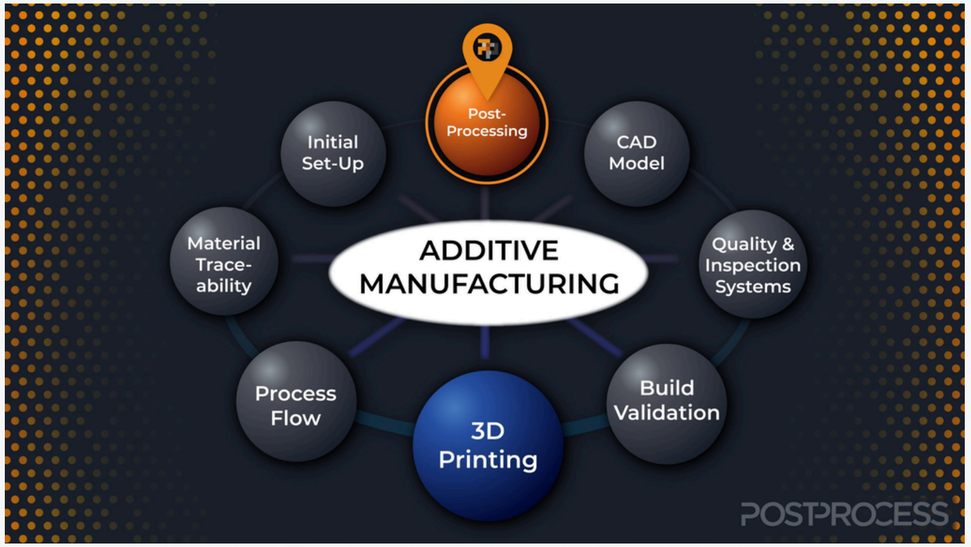
Subtractive Vs Additive Manufacturing Cost: Which Is More Expensive?



Advanced manufacturing processes:
Additive manufacturing technology

Advantages of Additive Manufacturing

- supply chain’s intermediate steps are removed
- Design directly from computer to the 3-D printer
- objects with functionally-graded materials
- different materials on the inside and outside.
- creating complex geometries and producing small lot sizes
- eliminate weight from an object
- setup costs producing small lots is cost effective



Advanced manufacturing processes:
Additive manufacturing technology

Challenges of Additive Manufacturing

- machines are expensive
- large lot sizes takes longer than with traditional manufacturing
- post-processing to clean and smooth out rough edges
- properties
- powders don’t quite sinter together - defects

Advanced manufacturing processes:

Additive manufacturing technology

Additive manufacturing versus conventional manufacturing

- traditional manufacturing is still faster and less expensive- granular products

  smaller the layer size, the slower the manufacturing
- initial products additively manufactured, but traditional manufacturing lot

  sizes increased to a certain point
- high demand, AM prevent excess inventory
- Caterpillar,Mercedes replacement parts within 24 hours, 3-D printers
- Aerospace, Racecars, and the Medical Field -AM
- AM used
  - function is more important than price.
  - small lot sizes or customization makes it less expensive

Advanced manufacturing processes:
Additive manufacturing technology

- **Material Jetting :** droplets in selected patterns, layer by layer, to build. completed layer cured by UV radiation.

- **Vat Photo Polymerization:** chemical reaction between photopolymers, ultraviolet light, and oxygen to produce 3D objects.
  - Continuous Digital Light Processing,
  - Digital Light Processing,
  - Stereolithography.
  -

- **Binder Jetting:**liquid binding agents with powdered material to deposit alternating layers of construction materials, bonding agent, and powder spreader

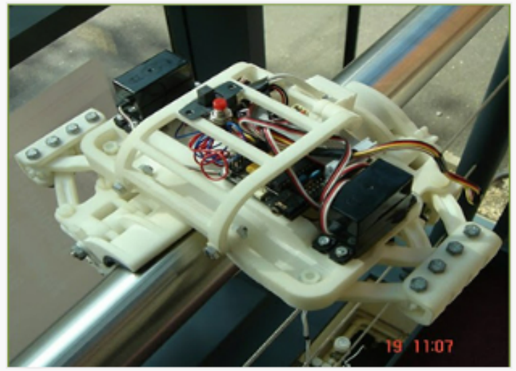
- **Material Extrusion:** Patented S. Scott Crump - Fused Deposition Modeling (FDM),
  - extrusion-thermoplastic filament that is fed through a heated nozzle.
  - filament is melted and placed layer by layer to produce a 3D object

Advanced manufacturing processes:
Additive manufacturing technology

VAT Photopolymerisation



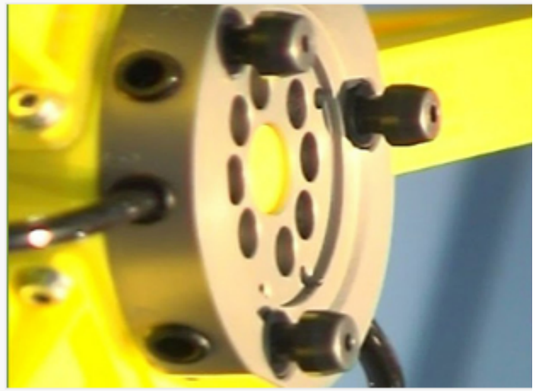
Material Jetting



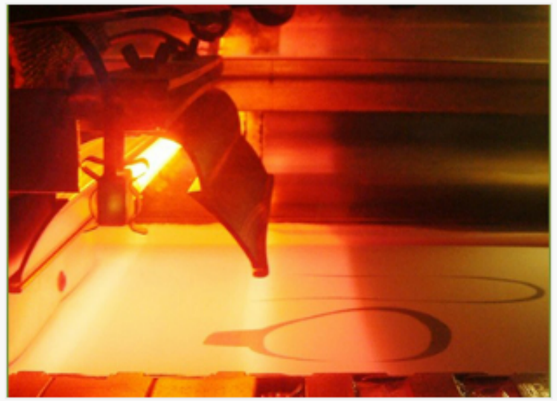
Binder Jetting



Material Extrusion



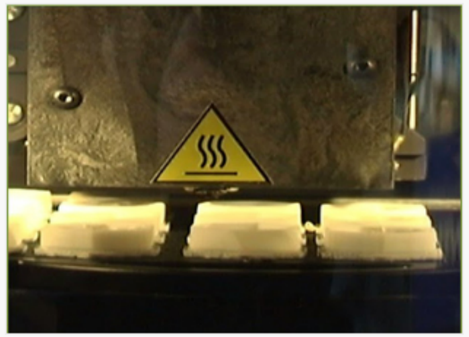
Powder Bed Fusion



Sheet Lamination



Directed Energy Deposition



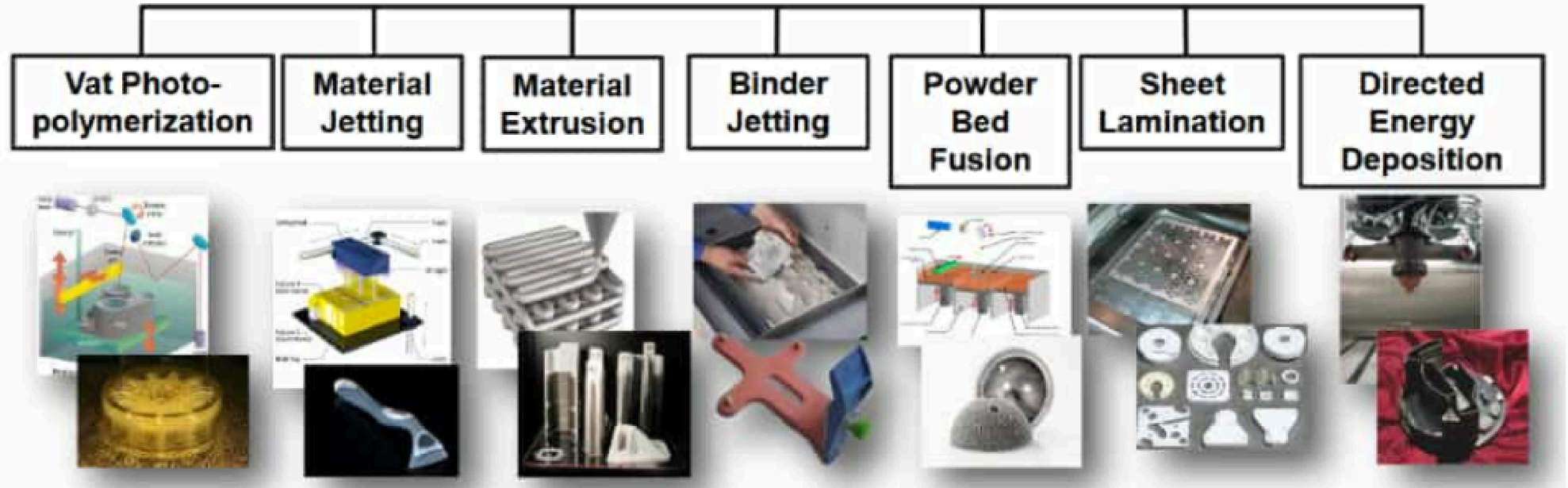
Advanced manufacturing processes:
Additive manufacturing technology

- **Powder Bed Fusion**
  - industrial additive manufacturing- laser sintering,
  - melts powdered material and fuses it via laser or electron beam to produce a 3D object.
    - selective heat sintering,
    - direct metal laser sintering,
    - electron beam melting,
    - selective laser melting,
    - laser sintering.
- **Sheet Lamination**
  - stacks laminate sheets of material to produce tangible items.
  - utilize ultrasonic additive manufacturing, laminated object manufacturing, and selective deposition lamination.
- **Directed Energy Deposition**

  welding processes, thermal energy to melt and fuse layers 3D object.

Advanced manufacturing processes:
Additive manufacturing technology

Types of Additive Manufacturing Processes



THANK'S

