# Lecture # 1

# 1 September 2020

# *Slide-02*

# TA201T: Introduction to Manufacturing Processes

## Course Objective...

Introduce fundamental concepts in Manufacturing using Materials

## You will learn about:

- various materials and their structure and properties
- how structure dictates properties
- how processing can change structure

## This course will help you to:

- decide judiciously on the manufacturing processes
- realize new design opportunities with materials

# Course Content

1. **Engineering materials**
2. **Microstructure processing relationship**
3. **Solidification processes**
4. **Molding and casting**
5. **Joining processes (Welding, Brazing and Soldering)**
6. **Deformation processes (Hot and Cold Working)**
7. **Powder metallurgy processing (Powder Production, Sintering)**
8. **Fe-C phase diagram and heat treatment**
9. **Surface modification (Carburization, CVD, PVD)**

# The Materials Selection Process

1. **Pick Application ⟶ Determine required Properties**

   **Properties: mechanical, electrical, thermal, magnetic, optical, deteriorative.**

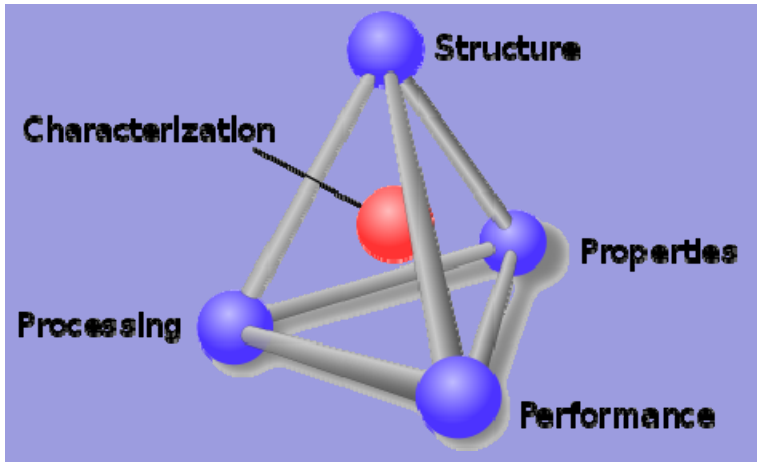
2. **Properties ⟶ Identify candidate Material(s)**

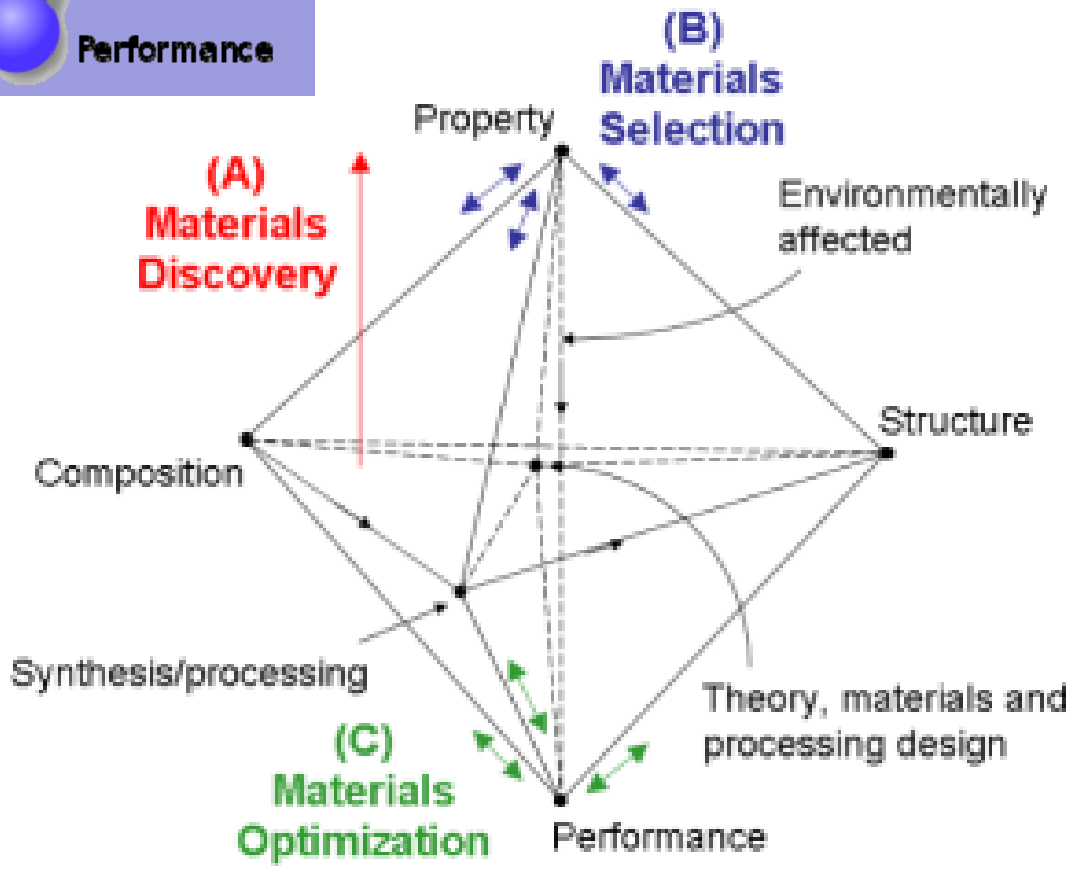
   **Material: structure, composition.**

3. **Material ⟶ Identify required Processing**

   **Processing: changes *structure* and overall *shape***
   **ex: casting, sintering, vapor deposition, doping forming, joining, annealing.**

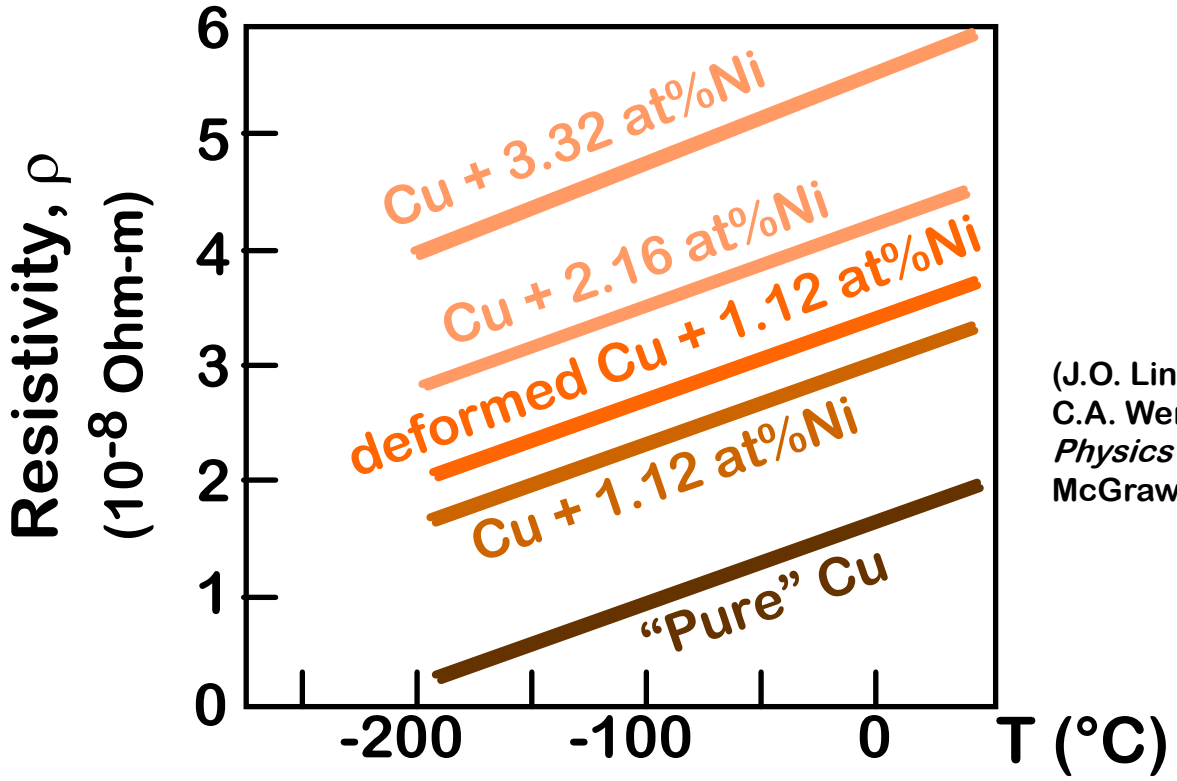
# Materials Tetrahedron



# ELECTRICAL

- **Electrical Resistivity of Copper:**

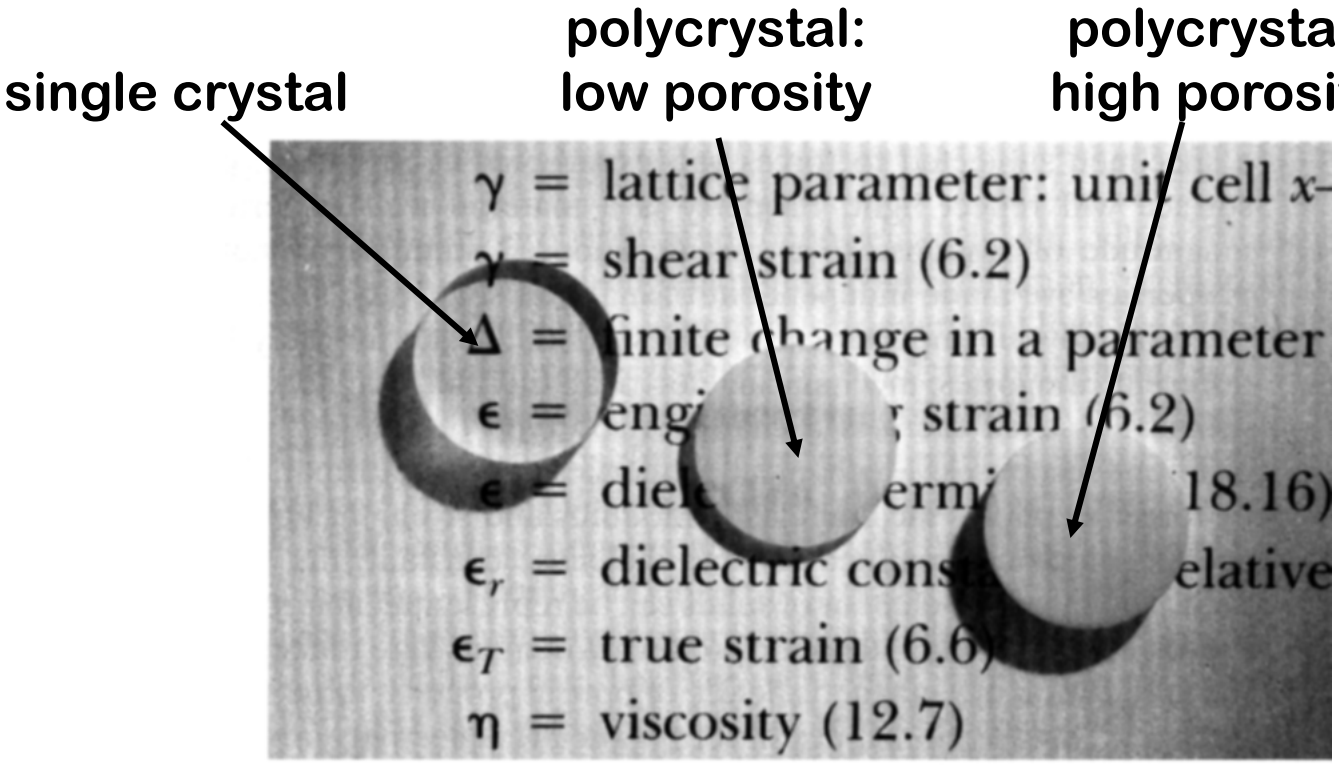



(J.O. Linde, *Ann Physik* **5**, 219 (1932); C.A. Wert and R.M. Thomson, *Physics of Solids*, 2nd ed., McGraw-Hill, New York,1970.)

- **Adding "impurity" atoms to Cu increases resistivity.**
- **Deforming Cu increases resistivity.**

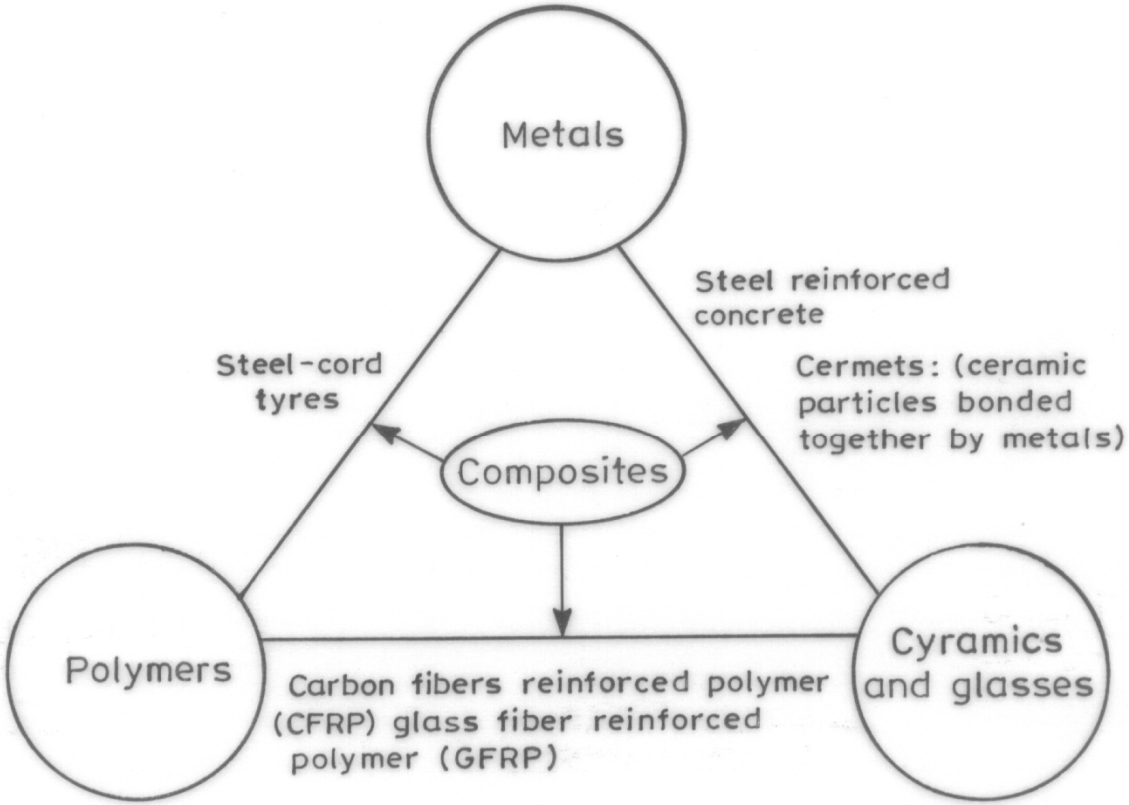
# OPTICAL

- **Transmittance:**
  **--Aluminum oxide may be transparent, translucent, or opaque depending on the material structure.**

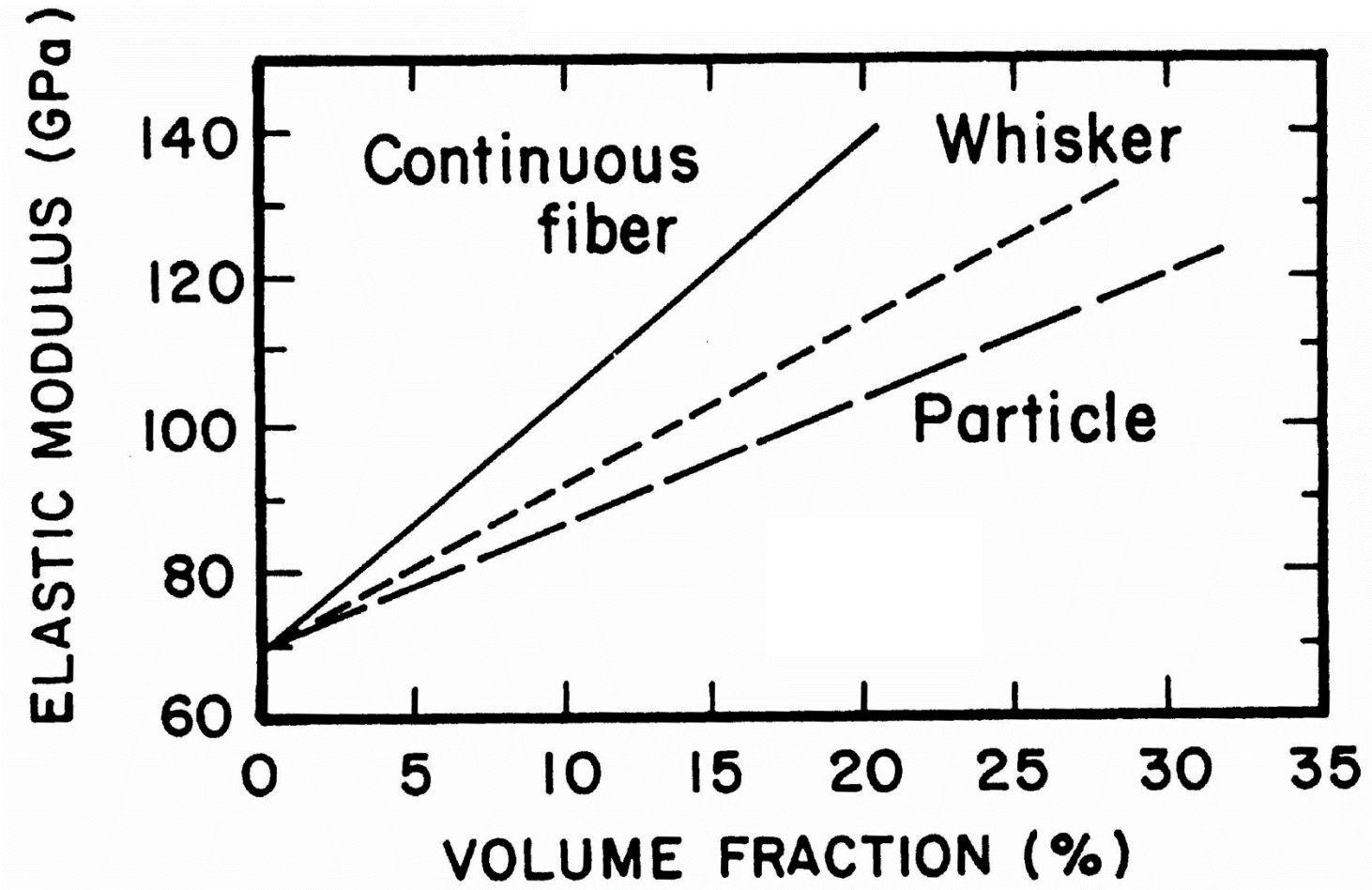



*Callister 6e*

# Classification of Various Types of Composites
## *with few illustrative examples*



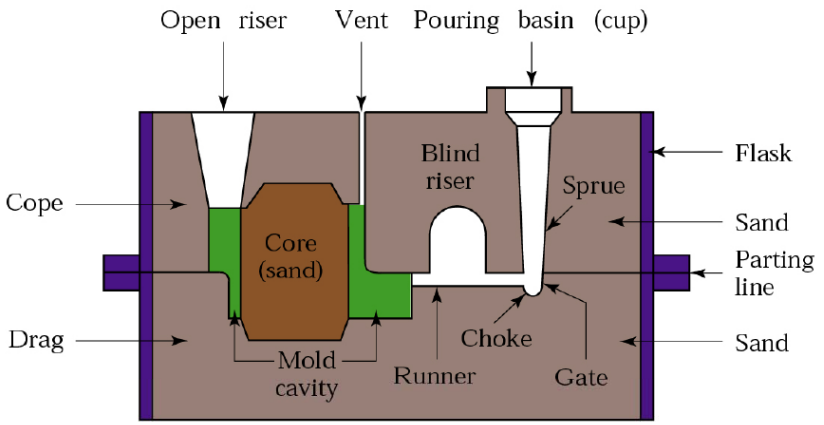
# Variation of Elastic Modulus of Composites with Varying Content and Morphology of the Reinforcing Phase

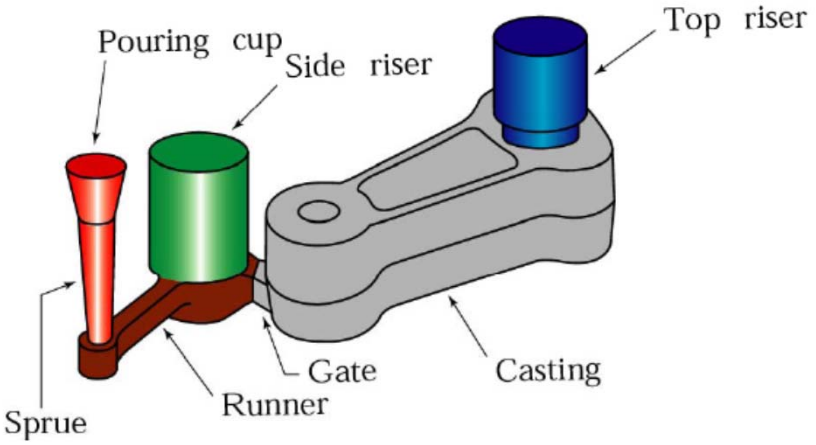


# Selection Criteria for Manufacturing Processes

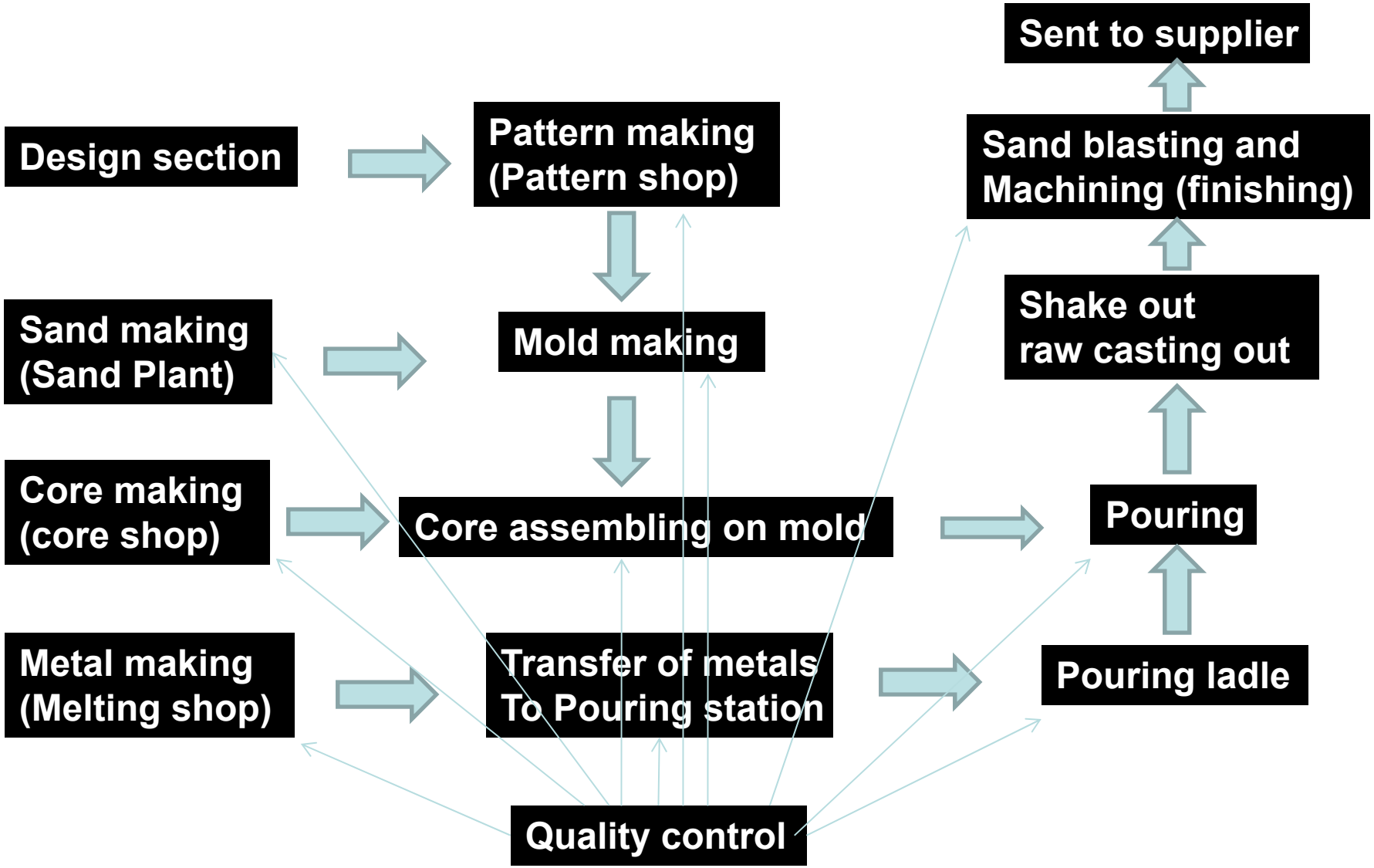
- **Manufacturing cost**
- **Production volume and production rate**
- **Characteristics and properties of work piece**
- **Limitations on shape and size**
- **Surface finish and tolerance requirements**
- **Functional requirements of the products**

# How would you make Engine block?




**Look at the complication and intricate design of engine block**


Sent to supplier
Design section
Pattern making
(Pattern shop)
Sand blasting and
Machining (finishing)
Shake out
raw casting out
Sand making
(Sand Plant)
Mold making
Core making
(core shop)
Core assembling on mold
Pouring
Metal making
(Melting shop)
Transfer of metals
To Pouring station
Pouring ladle
Quality control

# Some Videos

- Sand casting Video

http://www.youtube.com/watch?v=rgL2Jn5mk1A

- gas welding

http://www.youtube.com/watch?v=9P_QhTOnknQ

- Oxy-acetylene

http://www.youtube.com/watch?v=DWJQudCiUes&feature=related

- Brazing and welding

http://www.youtube.com/watch?v=TQP8EBQRvr0

- welding safety

http://www.youtube.com/watch?v=MVrI2kuRKdA&playnext=1&list=PLC415ABDC4A196A9D

- Open die forging

http://www.youtube.com/watch?v=tLRkOupbARM