

Collaborative Engineering

Design for Manufacturability



Team Work

- Conventional 'Serial Engg.'
- Design – Process – Product
- Process Capabilities


OrthoCAD Lab, I.I.T. Bombay

Current Practice – 'Serial Engineering'

Design and Manufacturing work in isolation

'Design is Holy' (No feedback is solicited)

Low initial pressure on Design dept.



THE WALL

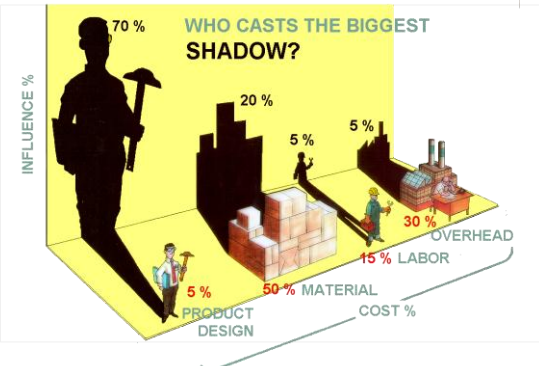
'Yes We Can' (No matter what cost)

Later high pressure on manufacturing

One way communication

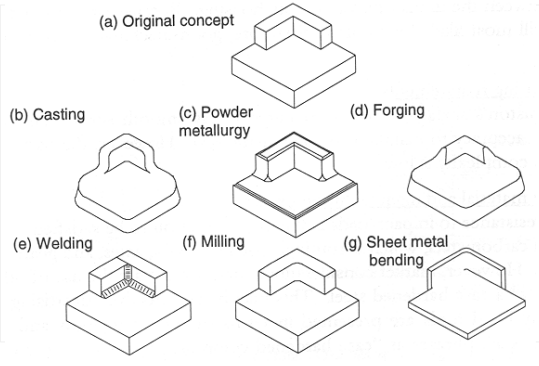
Current Practice – 'Serial Engineering'

WHO CASTS THE BIGGEST SHADOW?

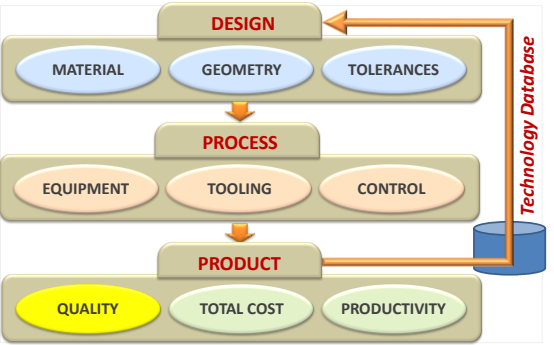


Category	Influence %
DESIGN	70%
MATERIAL	50%
LABOR	15%
OVERHEAD	30%
PRODUCT DESIGN	5%
50% MATERIAL COST %	5%

Product Design – Manufacturing Process



Product Design – Manufactured Product



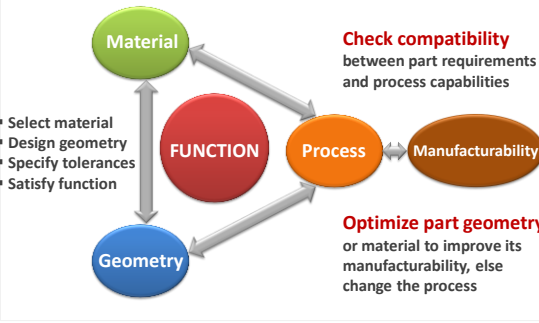
DESIGN (MATERIAL, GEOMETRY, TOLERANCES)

PROCESS (EQUIPMENT, TOOLING, CONTROL)

PRODUCT (QUALITY, TOTAL COST, PRODUCTIVITY)

Technology Database

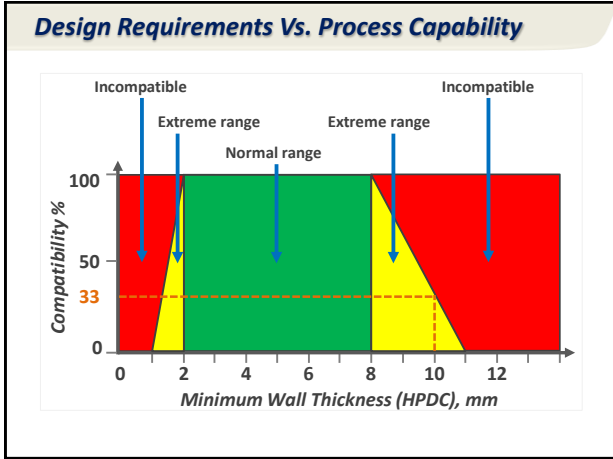
Design for Manufacturability



- Select material
- Design geometry
- Specify tolerances
- Satisfy function

Check compatibility between part requirements and process capabilities

Optimize part geometry or material to improve its manufacturability, else change the process



Processes Capabilities

Process / Attribute	Sand casting	Investment casting	Gravity die casting	Pressure die casting
Maximum weight	< 100 tons	< 40 kg	< 200 kg	< 10 kg
Maximum size	< 20 m	< 0.5 m	< 0.8 m	< 0.5 m
Minimum thickness	> 5 mm	> 1 mm	> 4 mm	> 1.5 mm
Minimum hole size	> 8 mm	> 4 mm	> 6 mm	> 2 mm
Intricate cored features	Possible	Possible	Partially	No
Dimensional tolerance	> 0.6 mm	> 0.1 mm	> 0.4 mm	> 0.05 mm

Processes Capabilities

Process / Attribute	Sand casting	Investment casting	Gravity die casting	Pressure die casting
Surface roughness	> 12 μm	> 4 μm	> 6 μm	> 2 μm
Economic quantity	Any	> 100	> 1000	> 10,000
Sample lead time	> 4 weeks	> 8 weeks	> 6 weeks	> 12 weeks
Relative cost for small order size	Lowest	Medium	High	Highest
Relative mechanical properties	Good	Best	Good	Very Good
Ease of redesign in production	Best	Fair	Poor	Poorest

- ### SUMMARY
- Conventional product development: serial engineering
 - Manufacturability issues are discovered late
 - By that time, it is too expensive to change the design
 - Design for manufacturability (DFM):
 - Predict and prevent potential problems early in lifecycle
 - Make part design compatible with process capabilities