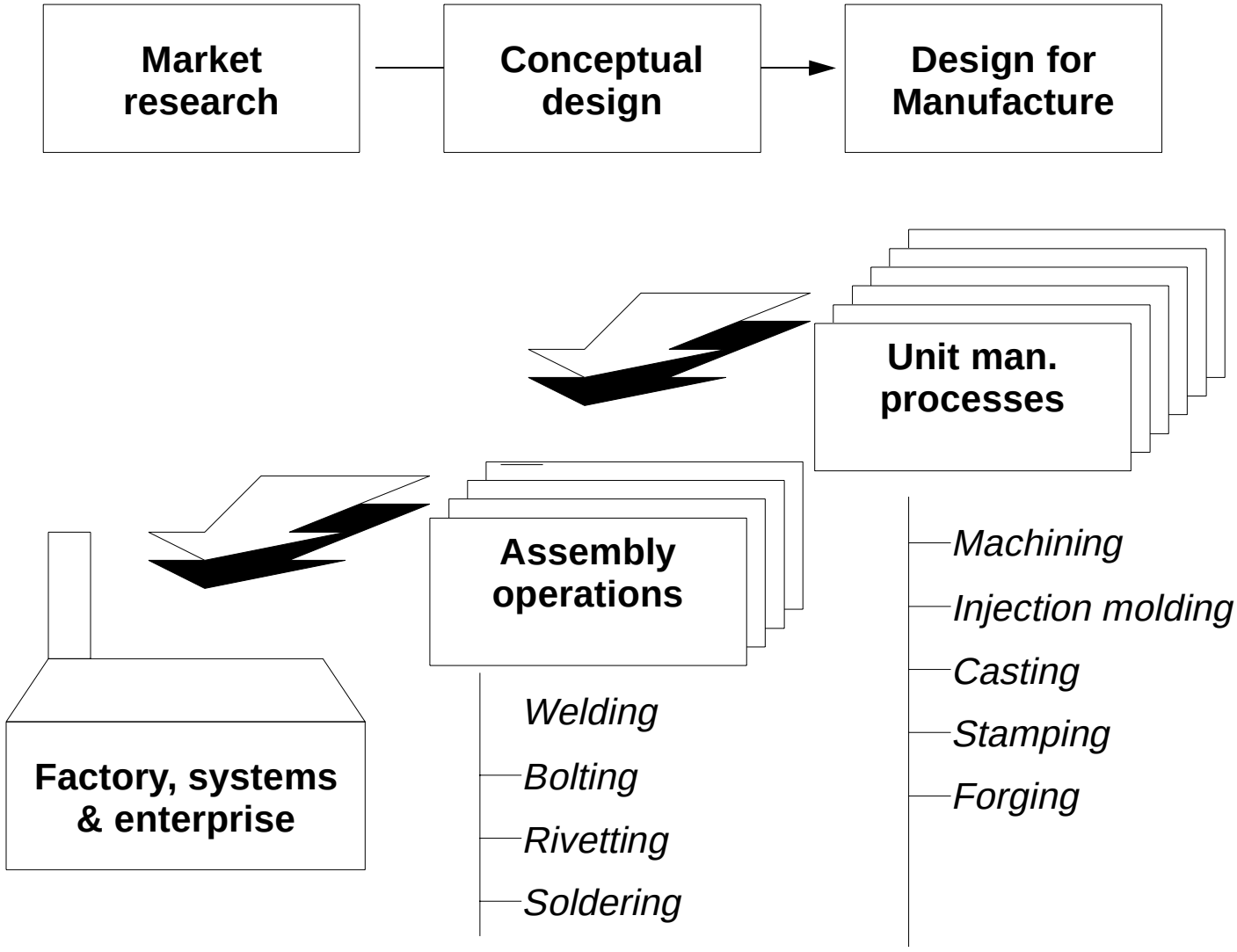
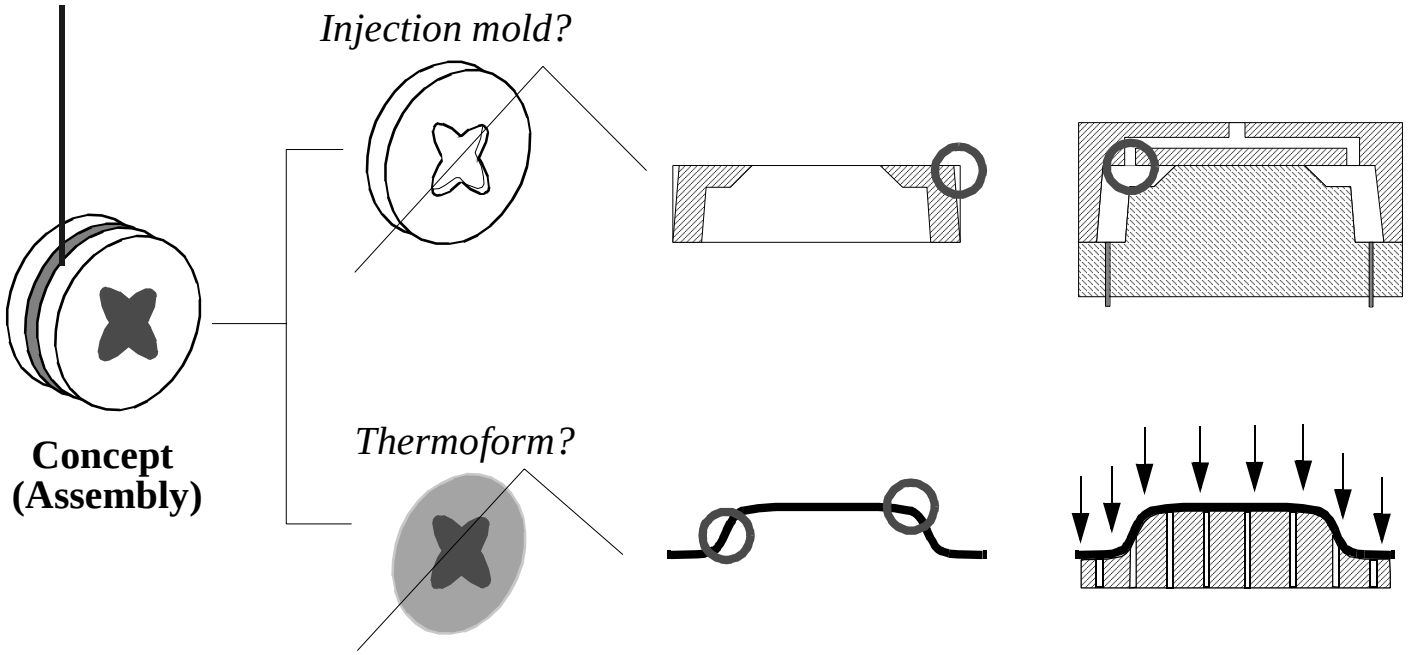
Manufacture



Design for Manufacture



Functional Requirements

Tentative breakup:

1. **MATERIAL**
2. **PROCESS**
3. **ASSEMBLY**

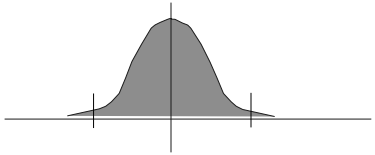
Concurrent Design:

1. **Design the *Process* around the part.**
2. **Modify the part to fit the *process*.**
3. **Verify funtional requirements!**

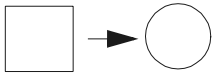
Process optimization

Cost
Can we make it cheaper?

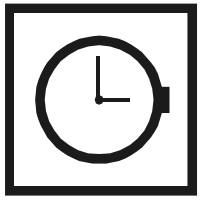
Process Quality
Can we improve the quality?



Capability
Equipment
Physics
DFM



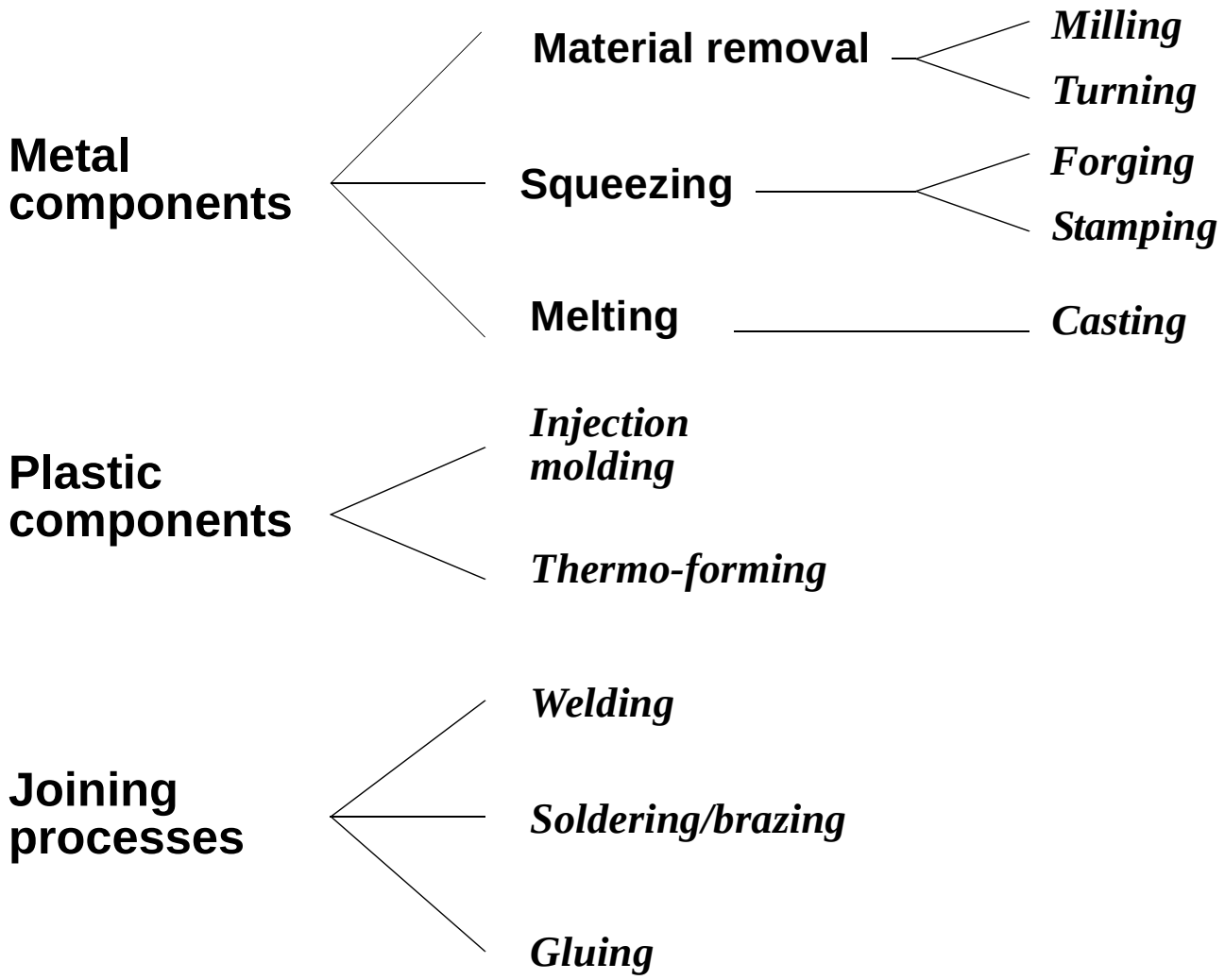
Flexibility
Can the process be modified?



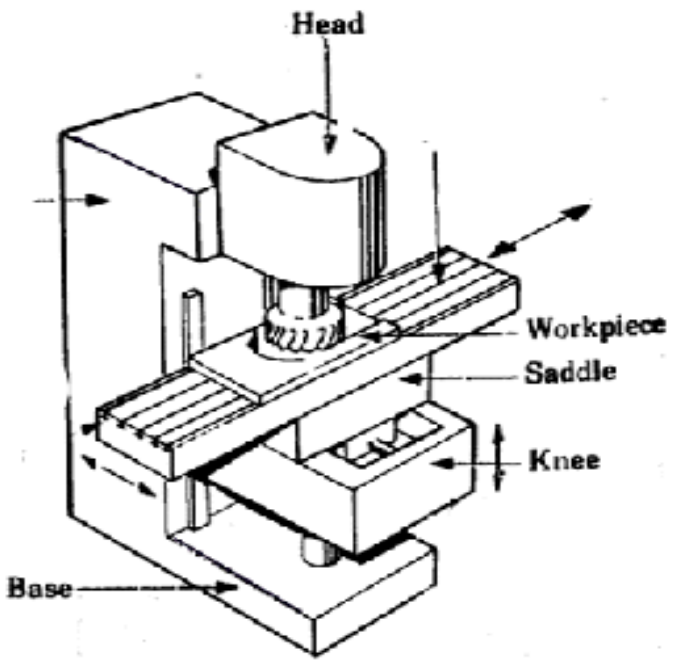
Rate
Can we make it faster?

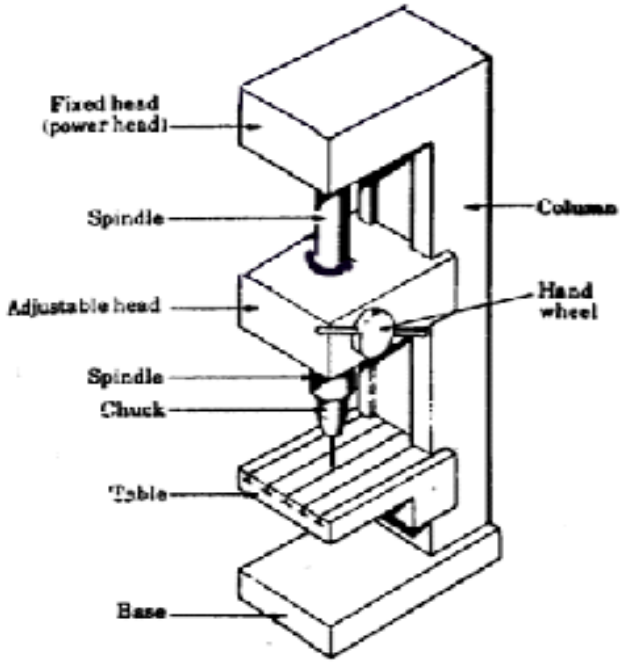
Effectiveness = A(cost) +B(Quality) + C(Flexibility) + D(Rate)

Processes we will study are:



Material removal (the oldest process)**:**





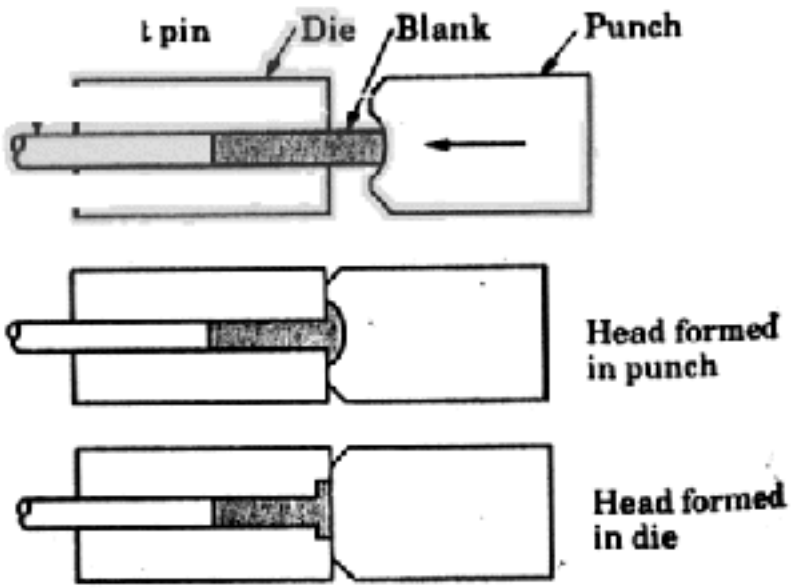
Cost: 👎
Expensive $100.00 — $10,000.00

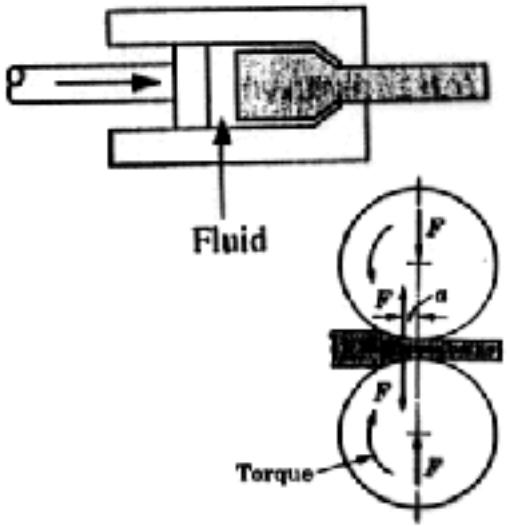
Flexibility: 👍
Any shape under the sun!

Quality: 👍
Very high quality.

Rate: 👎
Slow compared to other production techniques.

Metal Squeezing:





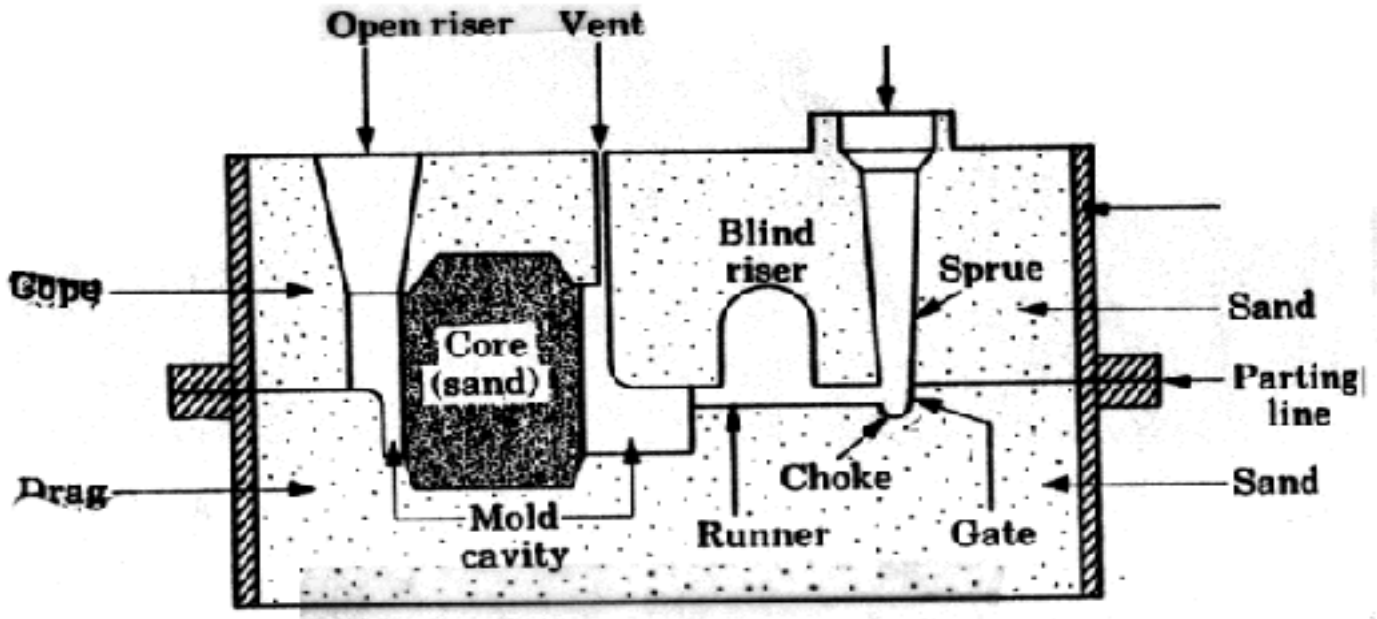
Cost: 👍
Cheap: $0.1 - $100.00

Flexibility: 👎
Fixed by die shape. Dies take days to manufacture. Shapes limited.

Quality: ~
Reasonable quality.

Rate: 👍
Fast, high volume.
Cycle time ~ seconds

Melting:



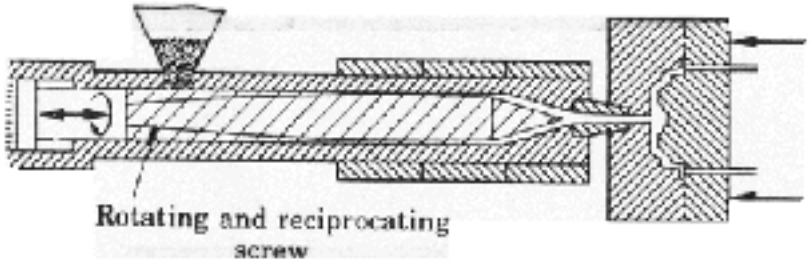
Cost: 👎
Expensive: $100.00 - $10,000.00

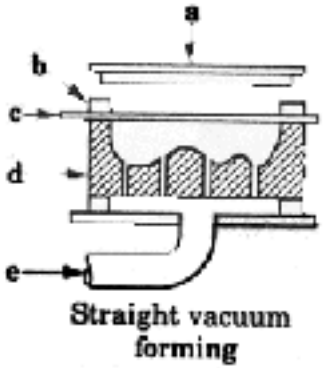
Flexibility: 👍
Very flexible in shape. Good (and cheap) for large parts. Wooden patterns.

Quality: 👎
Post-finishing mandatory.

Rate: 👎
Very very slow. Hours.

Plastics processing:





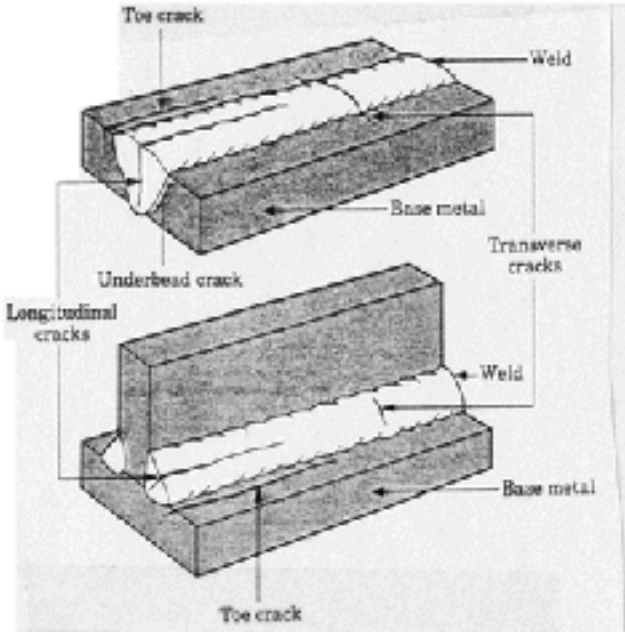
Cost: ☞
Expensive $100.00 — $10,000.00

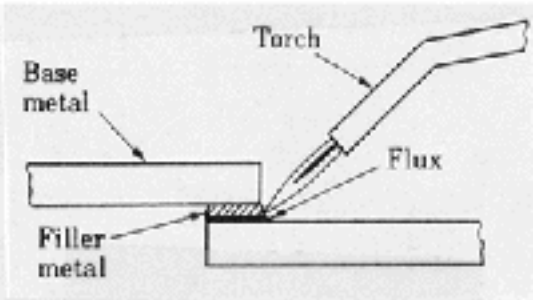
Flexibility: ~~
Dies need to be prepared.

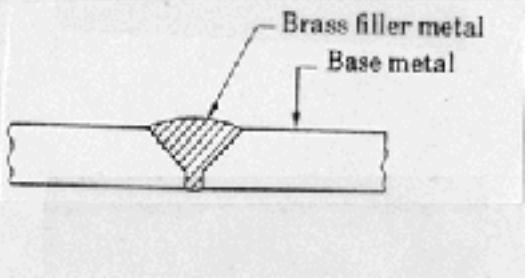
Quality:~~
Very high quality.

Rate: ☞
Very fast. Several seconds.

Joining:







Cost: 👍
Cheap.

Flexibility: 👍 👎
Quite flexible when manual, but inflexible when automated.

Quality: 👍
Range of quality.

Rate: 👎 👍
Depends!

Conclusions

- Must understand the physics to optimize each process.
- Must understand process specifics to design a system.
- Must understand the process to design the part.
- *A designer who doesn't understand manufacturing is a bad designer.*