

DFA

(Design for Assembly)

- **Definition and Purpose**

- Design for Assembly is a method of analyzing components and sub-assemblies in order to:
 - Optimize the assembly process steps
 - Identify part relevance
 - Estimate the cost of assembly
- The purpose of DFA is to minimize assembly cost by optimizing the assembly process and reducing the number of parts.

DFA Process

- ***Prior to examining a system for DFA you need***
 - ***a model, drawing or prototype of the assembly***
 - ***a proposed assembly sequence.***

Examine Assembly Steps

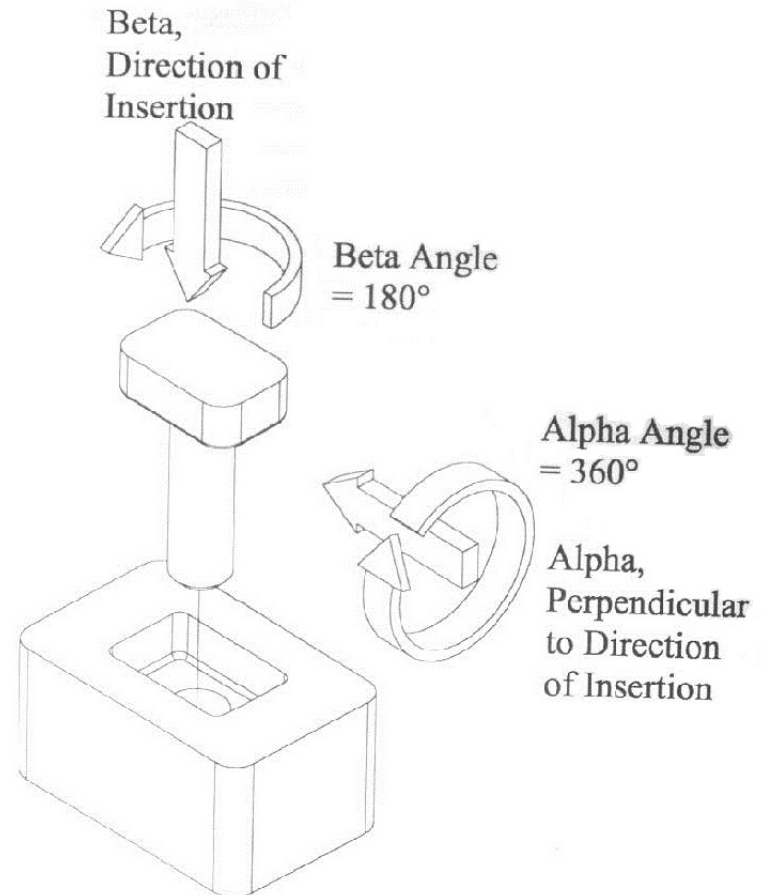
- Part handling
- Part insertion/orientation
- Non-value added process steps

Examine Part Relevance

- Minimize part count
- Determine theoretical minimum number of parts
- Minimize the levels of assembly

Part Handling

- Design parts that are easy to handle
 - Alpha/Beta angle symmetry
 - Alpha: axis perpendicular to direction of insertion
 - Beta: axis in direction of insertion



Part Handling

- Geometric Size
 - Design parts that are “ideal” in terms of size
 - Large parts
 - Require two hands
 - Require mechanical assistance
 - Tiny parts
 - Require tweezers
 - Require magnification

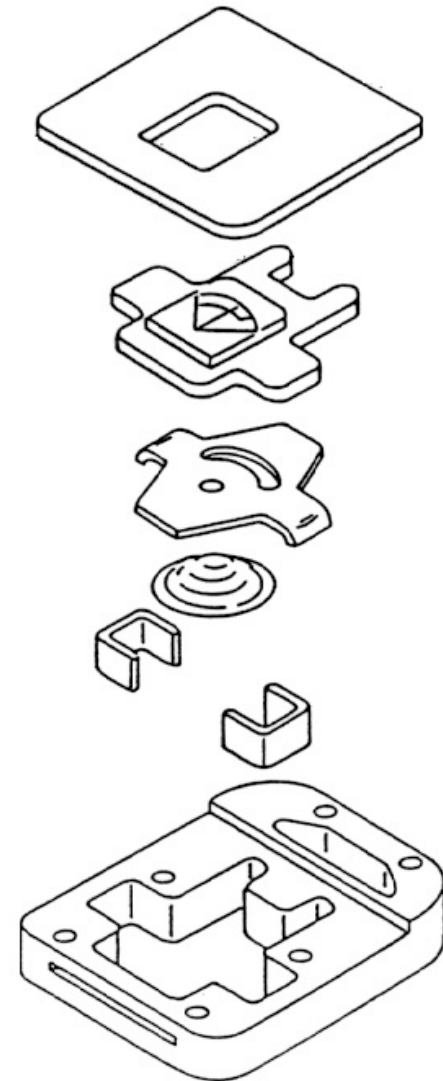
Part Handling

- If possible, minimize
 - Flexible parts (wiring, tubing, gaskets)
 - difficult handling
 - Parts that tangle
 - Slippery or sticky parts
 - (pre-lubricated, pre-adhesive)
 - Parts with sharp edges or points

Part Insertion

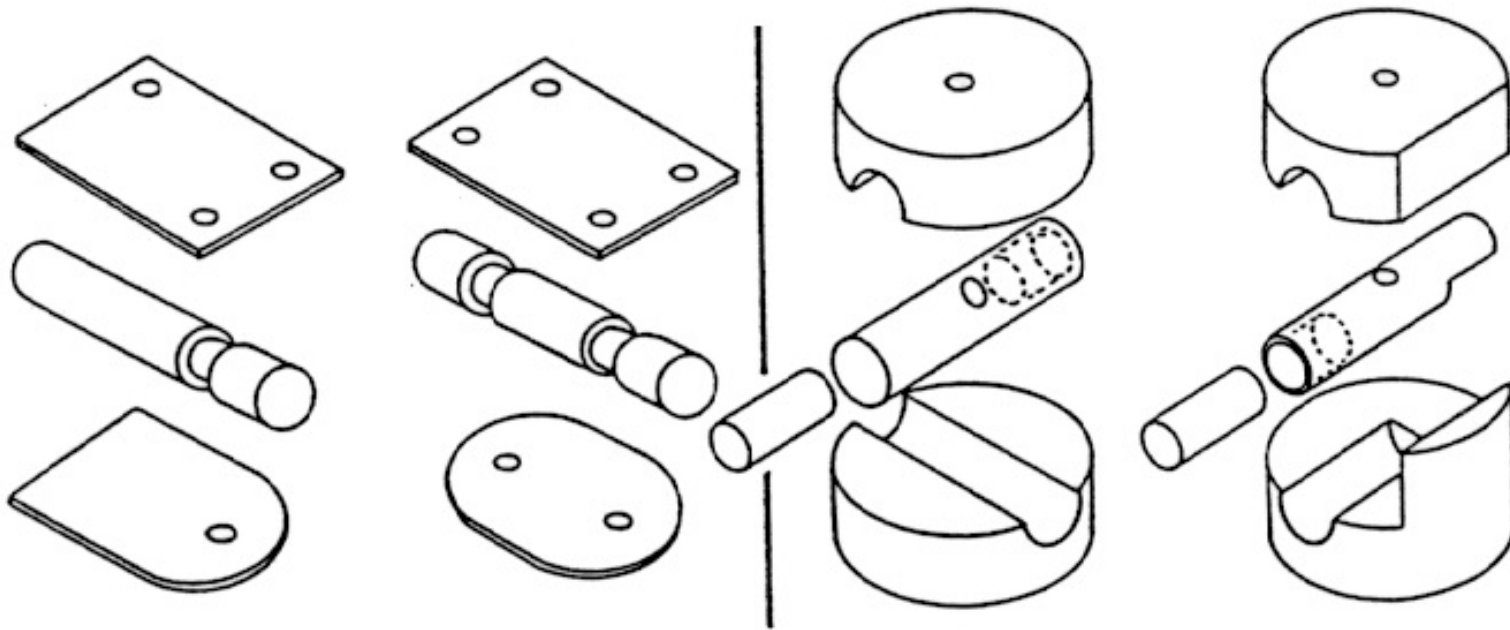
Design for uni-directional assembly,
preferably using gravity

Assembly to a stable base



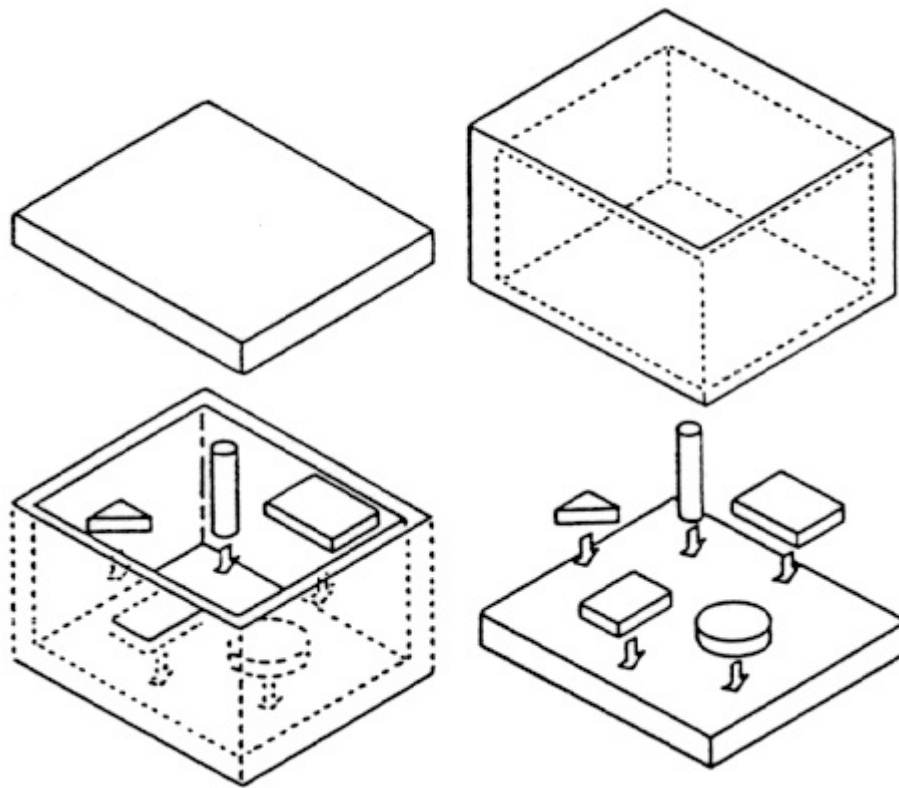
Part Insertion

Design parts that are easy to align and position,
design parts that self-fixture.



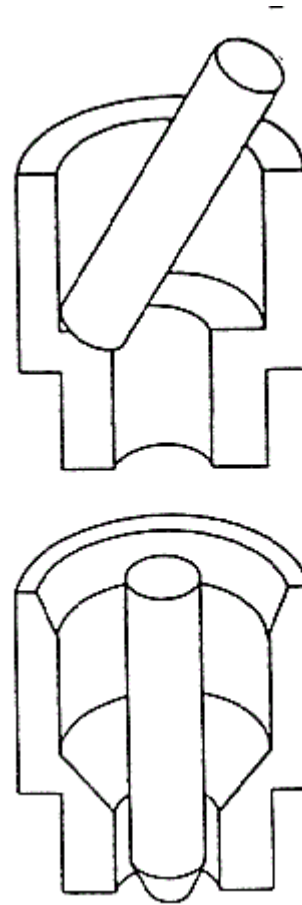
Part Insertion

Consider access and visibility for ease of insertion.



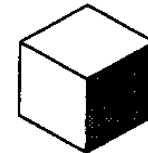
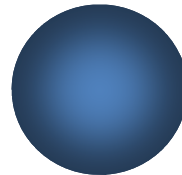
Part Insertion

Design parts that self align

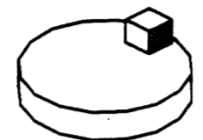
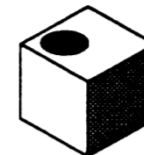
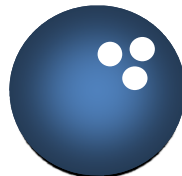


Mistake Proofing Issues (Poka-Yoke)

- Cannot assemble wrong part
- Cannot omit part
- Cannot assemble part wrong way around.



symmetrical parts

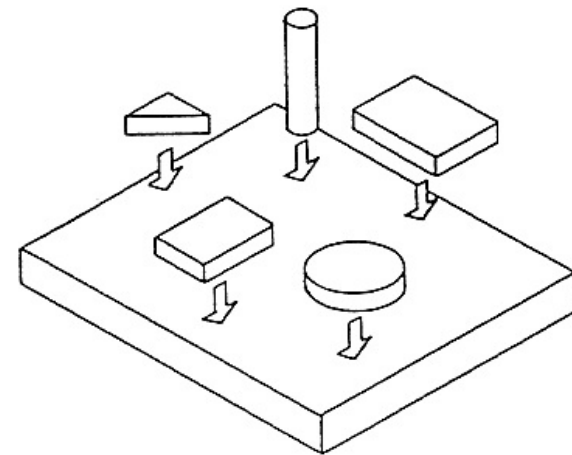
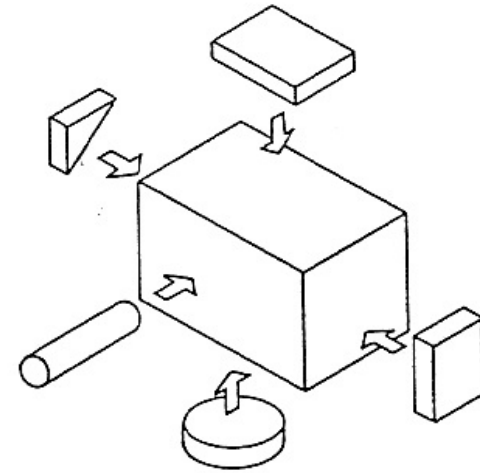


asymmetrical parts

Part Insertion

Avoid the need for adjustments and reorientations during assembly

Use unidirectional assembly where possible

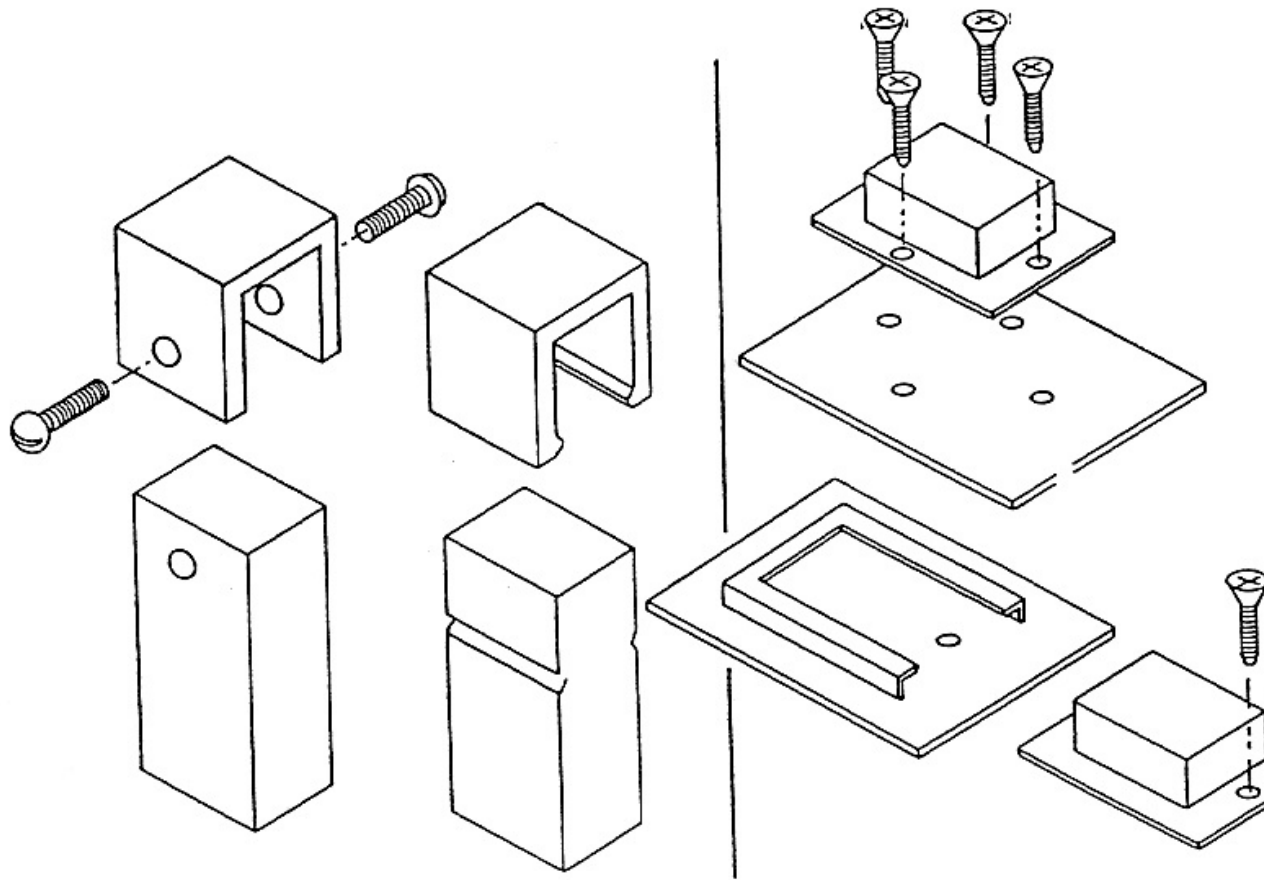


Minimize Part Count

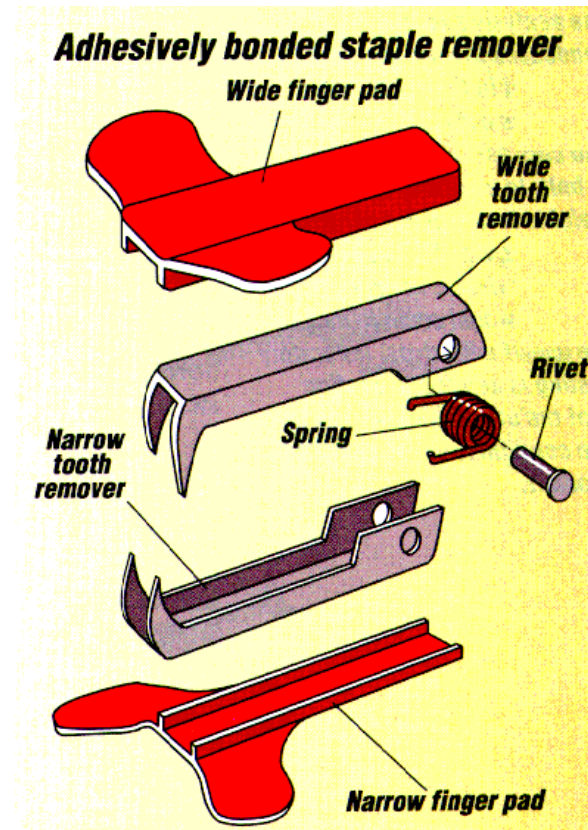
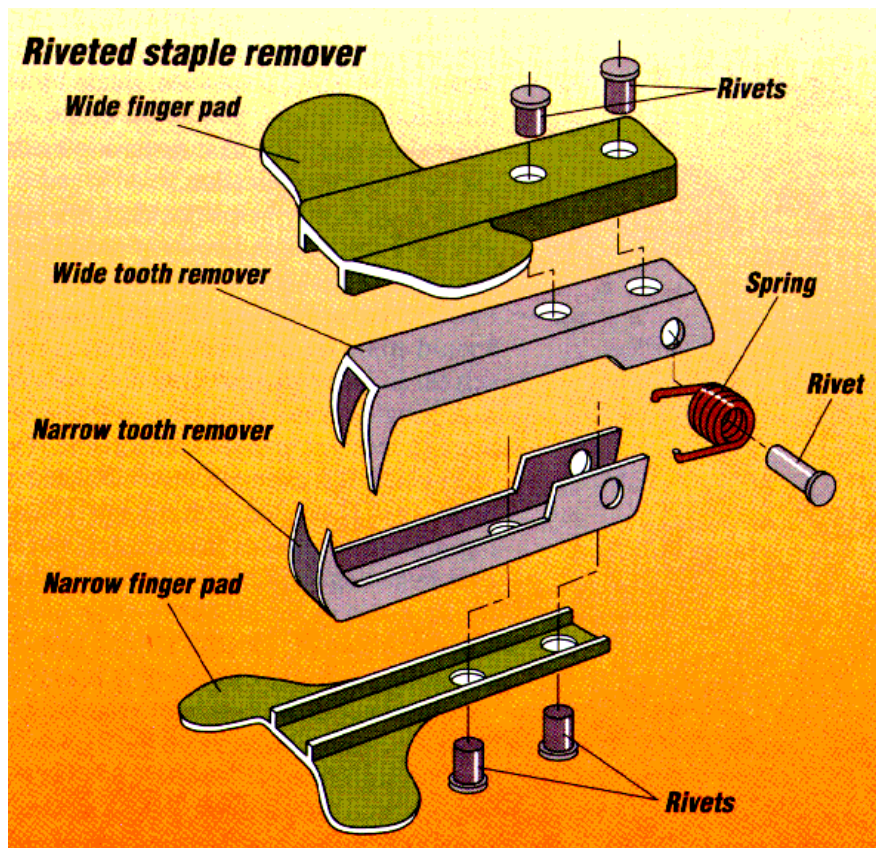
- Design for the minimum number of without sacrificing quality.
- Fewer parts mean
 - a faster and more accurate assembly process
 - it results in:
 - Reduced inventory and number of vendors
 - Reduced assembly time and savings in material costs
 - Simplified assembly processes
- It can be accomplished by:
 - Minimizing numbers and types of fasteners, cables, etc.
 - Encouraging modular, interchangeable assemblies
 - Building in self-fastening features
 - Minimizing the number of levels of assembly

Eliminating Parts

Avoid separate fasteners: design the fastening functions into the parts.

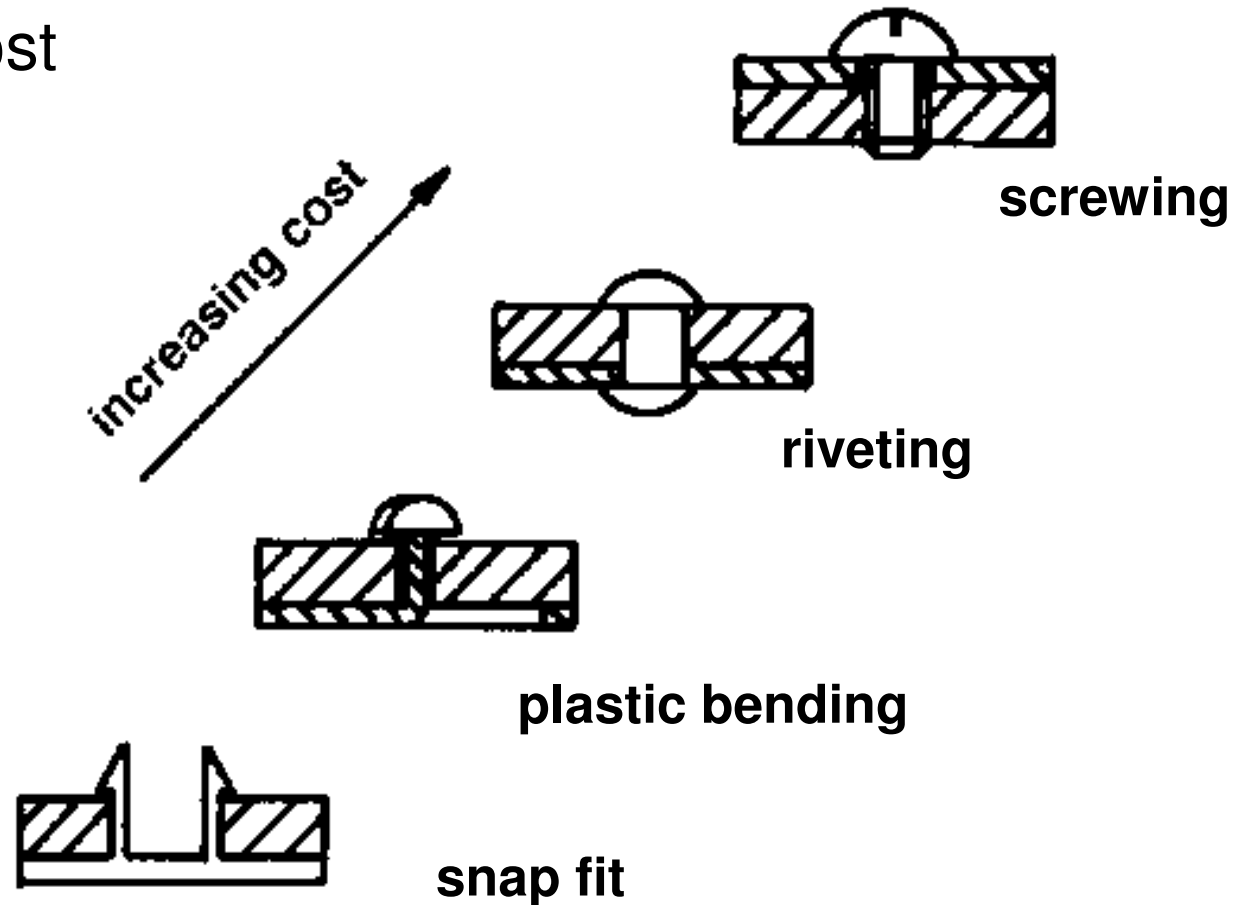


Eliminating Fasteners

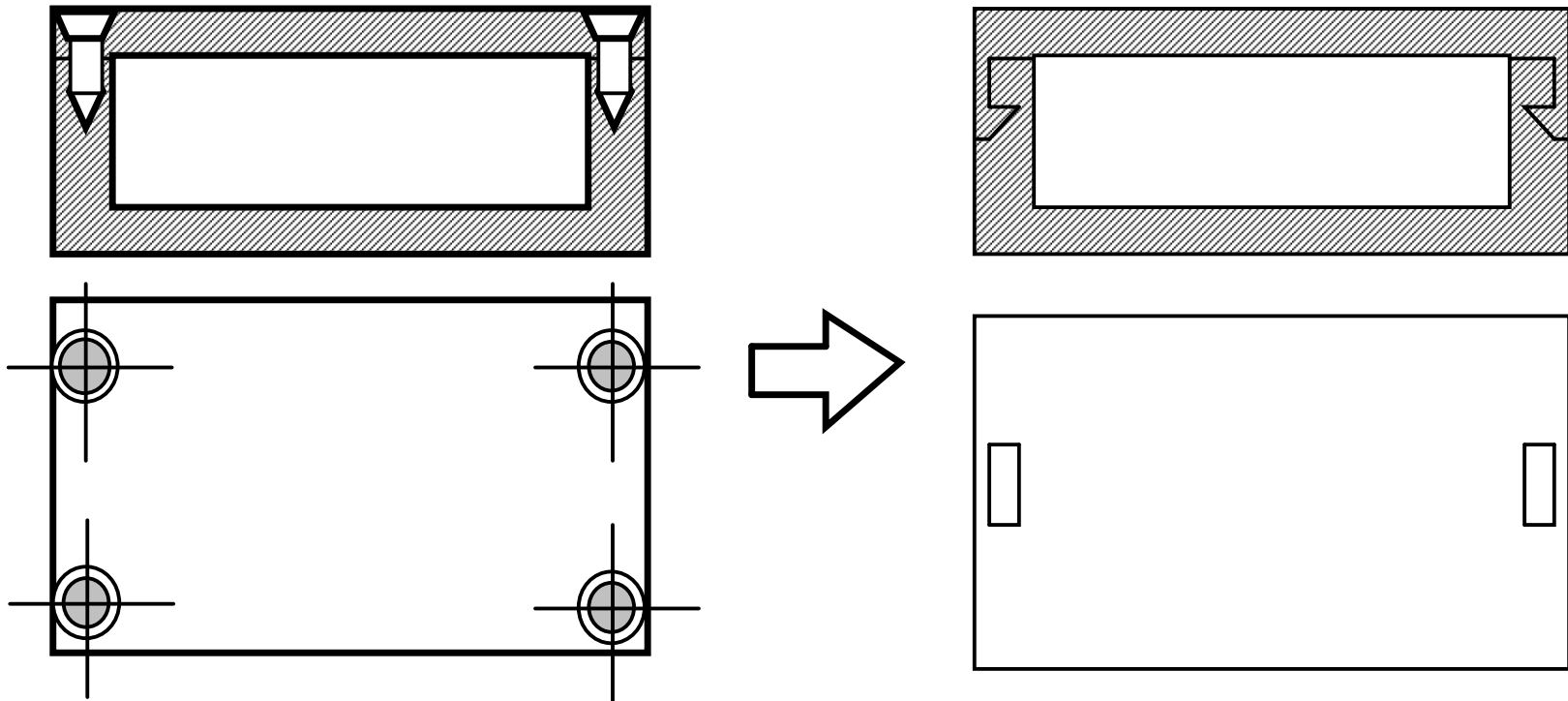


Fastener Cost

- Select the most inexpensive fastening method required



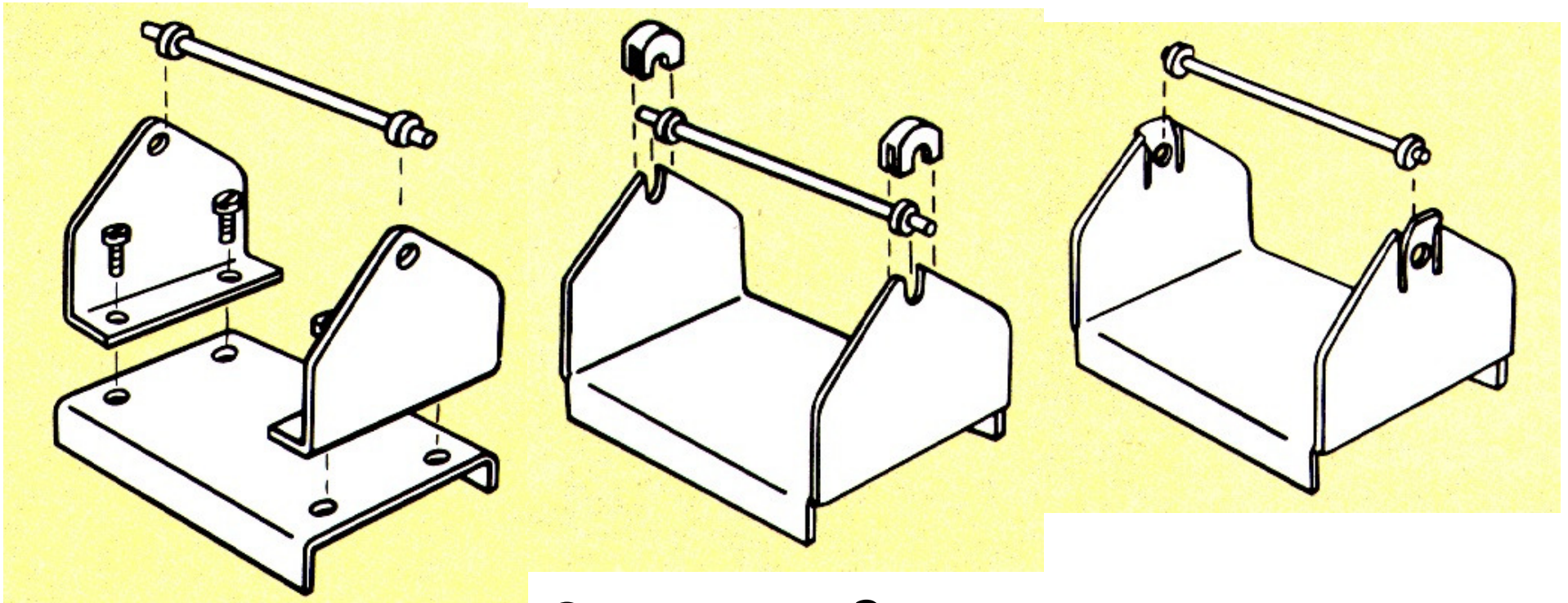
Self-Fastening Features



Theoretical Number of Parts

- 1) Is the component/sub-assembly used only for fastening or securing other items? If yes, try to eliminate.
- 2) Is the component/sub-assembly used only for connecting other items (for example, wiring harnesses, belts, chains)? If yes, try to eliminate.
- 3) During operation, does the component move relative to all other parts already assembled? If no, skip question #4
- 4) Must the part be made of a different material than, or isolated from all other parts already assembled? Only fundamental reasons concerned with material properties are acceptable. If no, go to question #5
- 5) Must the part be separate from all other parts already assembled because of any necessary assembly or disassembly of the other parts would otherwise be impossible? If no to questions #3-5, part is theoretically unnecessary.
- 6) If this is a part in a sub-assembly, can any part be combined with another part in the parent assembly?

Three solutions to the same design issue.



Comments?

Which do you prefer?

Why?

DFA Software

- Will allow user to see the effects of part handling decisions.
- Will help user to work toward minimizing part count.