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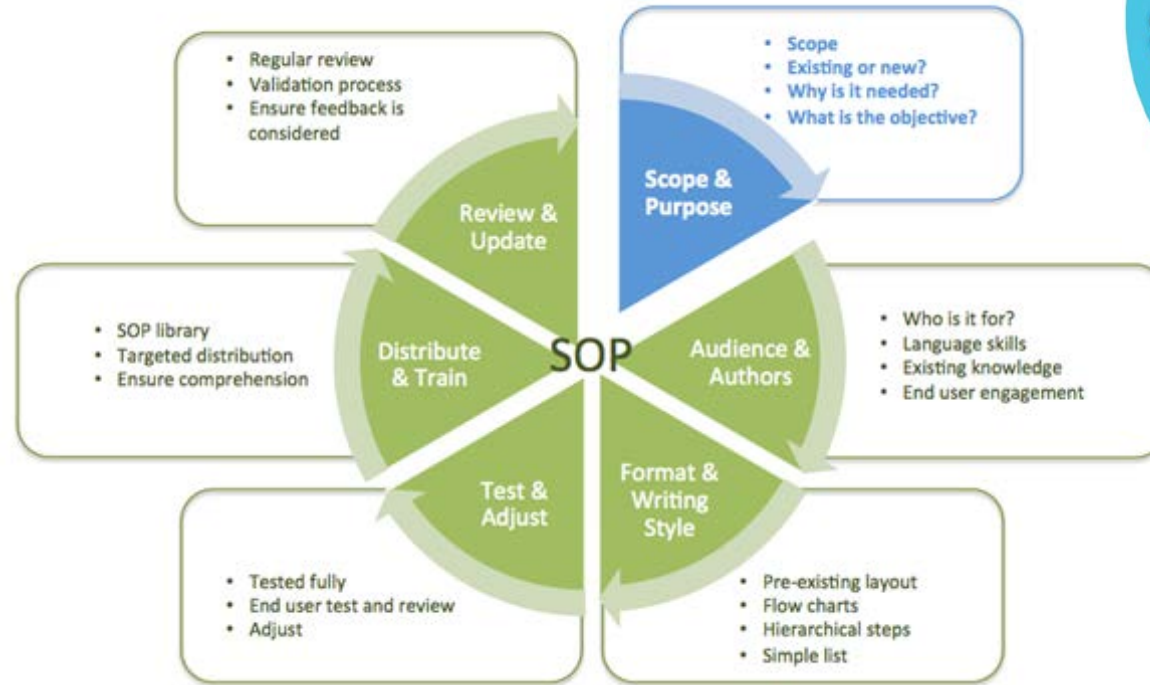
Trinity Saint David

Design for Assembly (DFA)

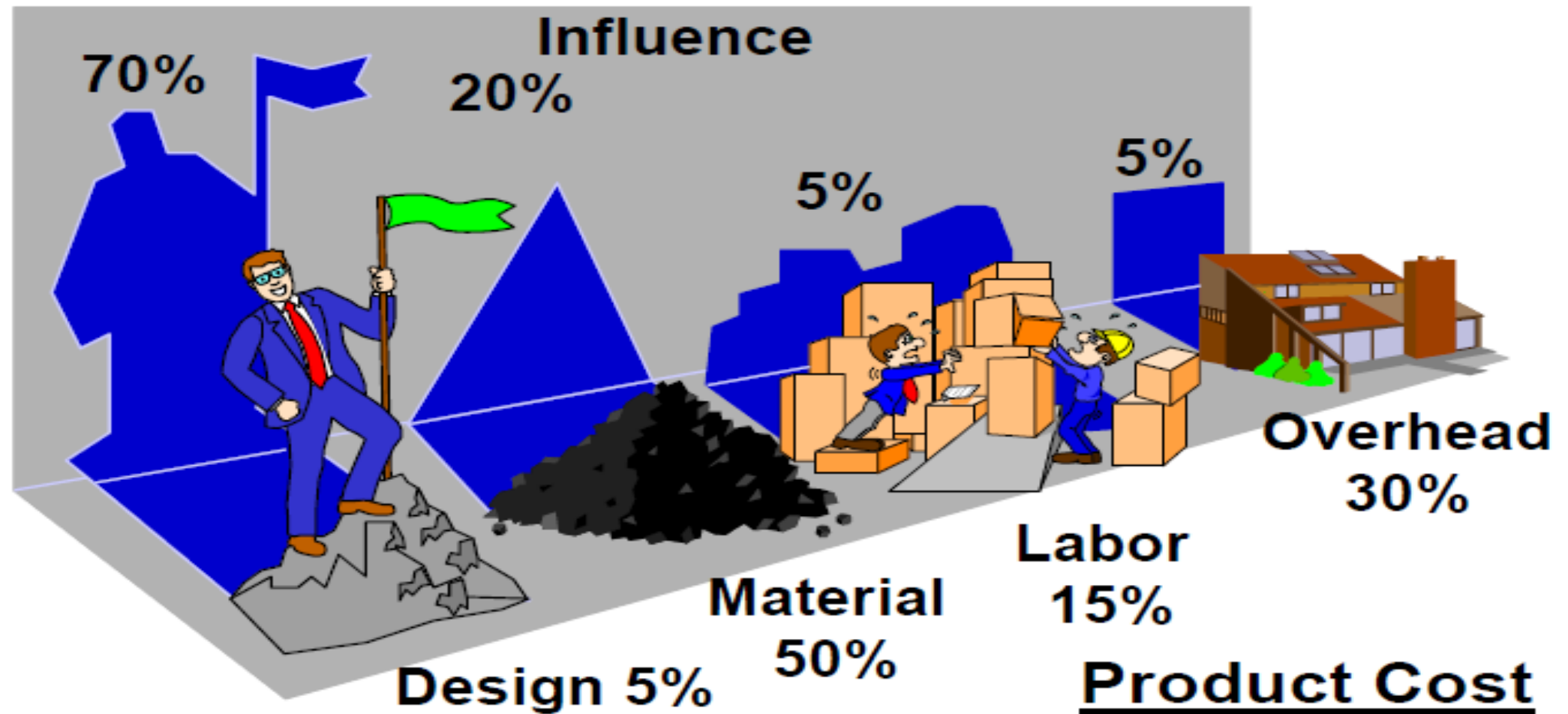
Design for Assembly (DFA) is a sometimes considered a subset of Design for Manufacture (DFM)

To maximize ease and efficiency of assembly operations, we can optimise the assembly process:

- Tools
- Handling aids
- SOPs
- 5S
- Workstation design
- Line design



We can (and should) also optimise the design of components and assemblies. Remember the graphic:



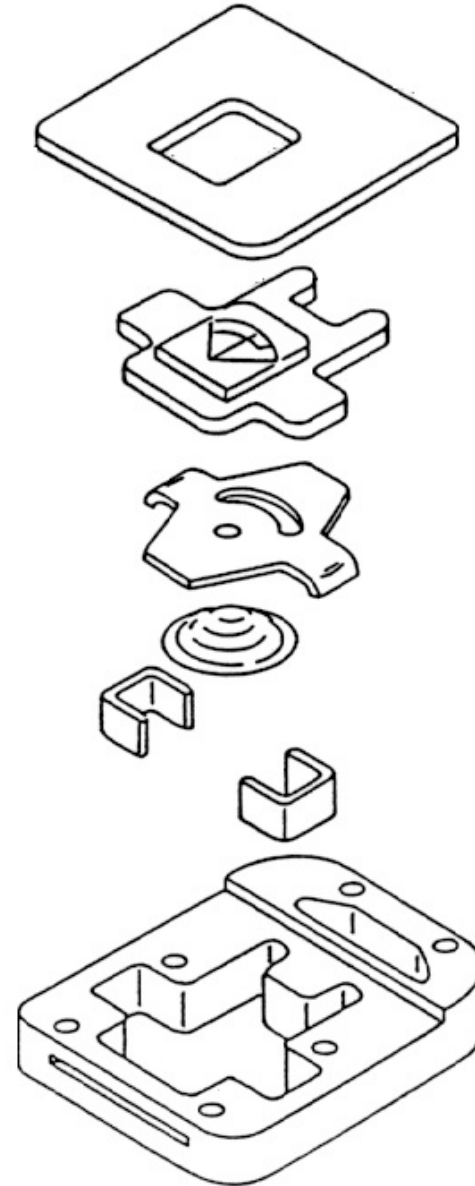
7 Design for Assembly (DFA) Principles

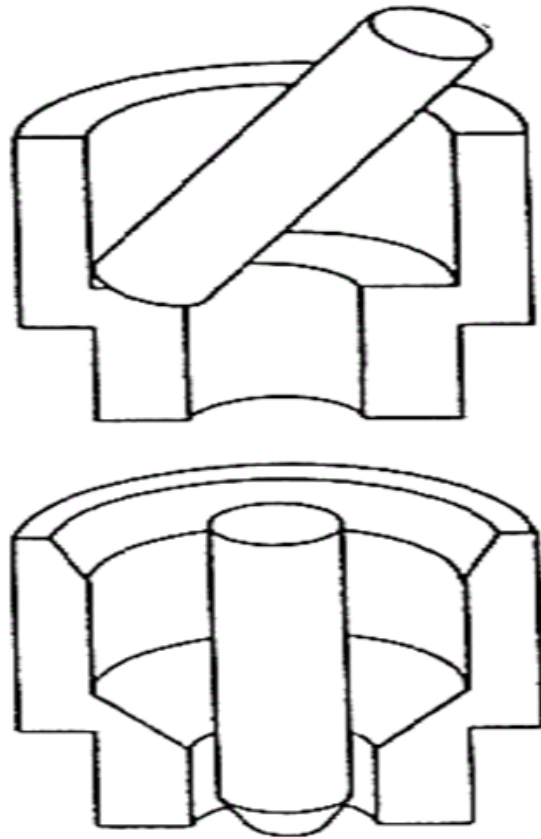
Aims

- Maximise ease of assembly
- Reduce opportunity for errors
- Reduce the need for in process or post process inspection
- Decrease assembly time
- Improve efficiency
- Improve H&S

Design for Assembly (DFA) Principles

1. Part is inserted from top
(above)





Design for Assembly (DFA) Principles

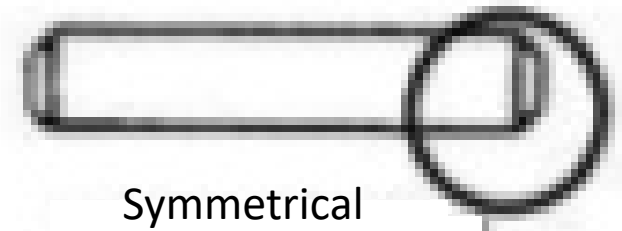
2. Parts are self aligning

Design for Assembly (DFA) Principles

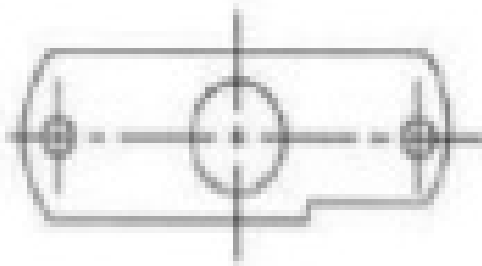
3. Part does not need to be oriented



Asymmetrical



Symmetrical



Asymmetrical



Symmetrical



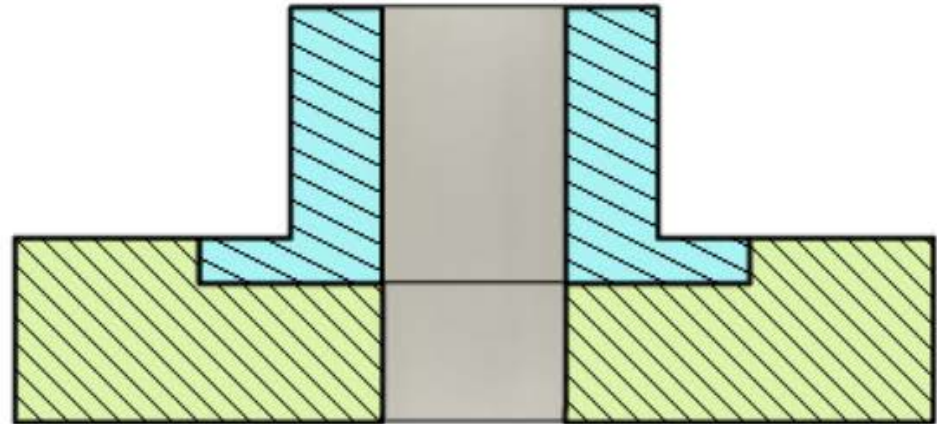
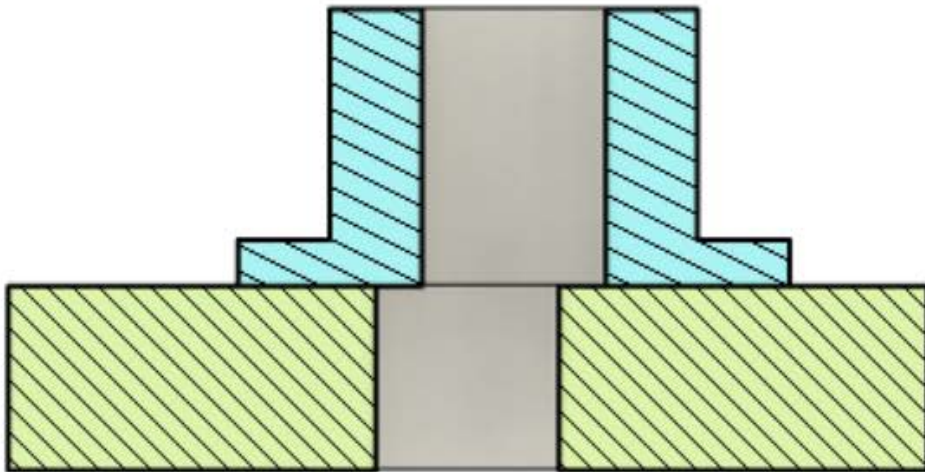
Slight
asymmetry



Pronounced
asymmetry

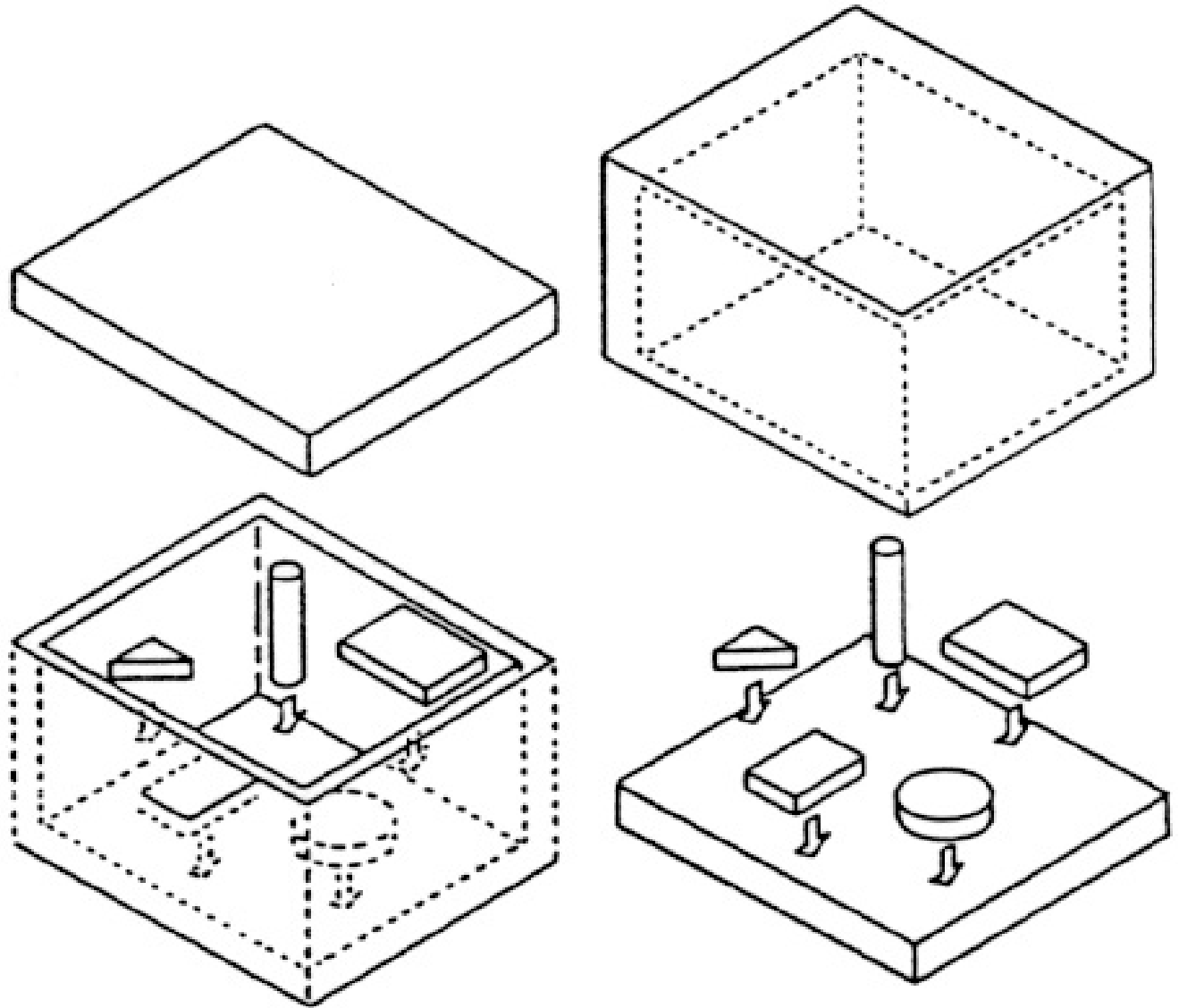
Design for Assembly (DFA) Principles

4. Part requires only one hand for assembly



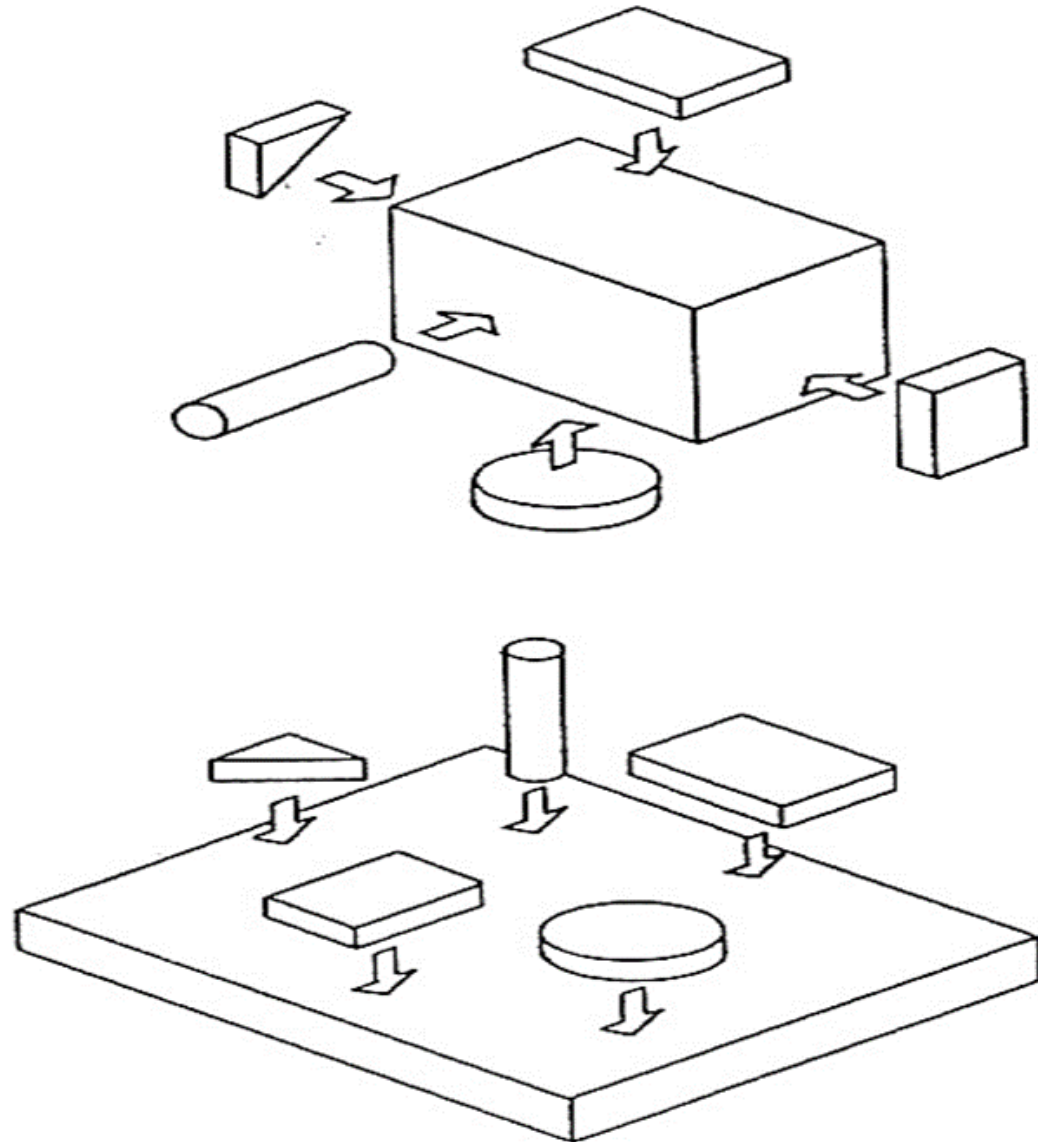
Design for Assembly (DFA) Principles

5. Part requires no tool/s for assembly



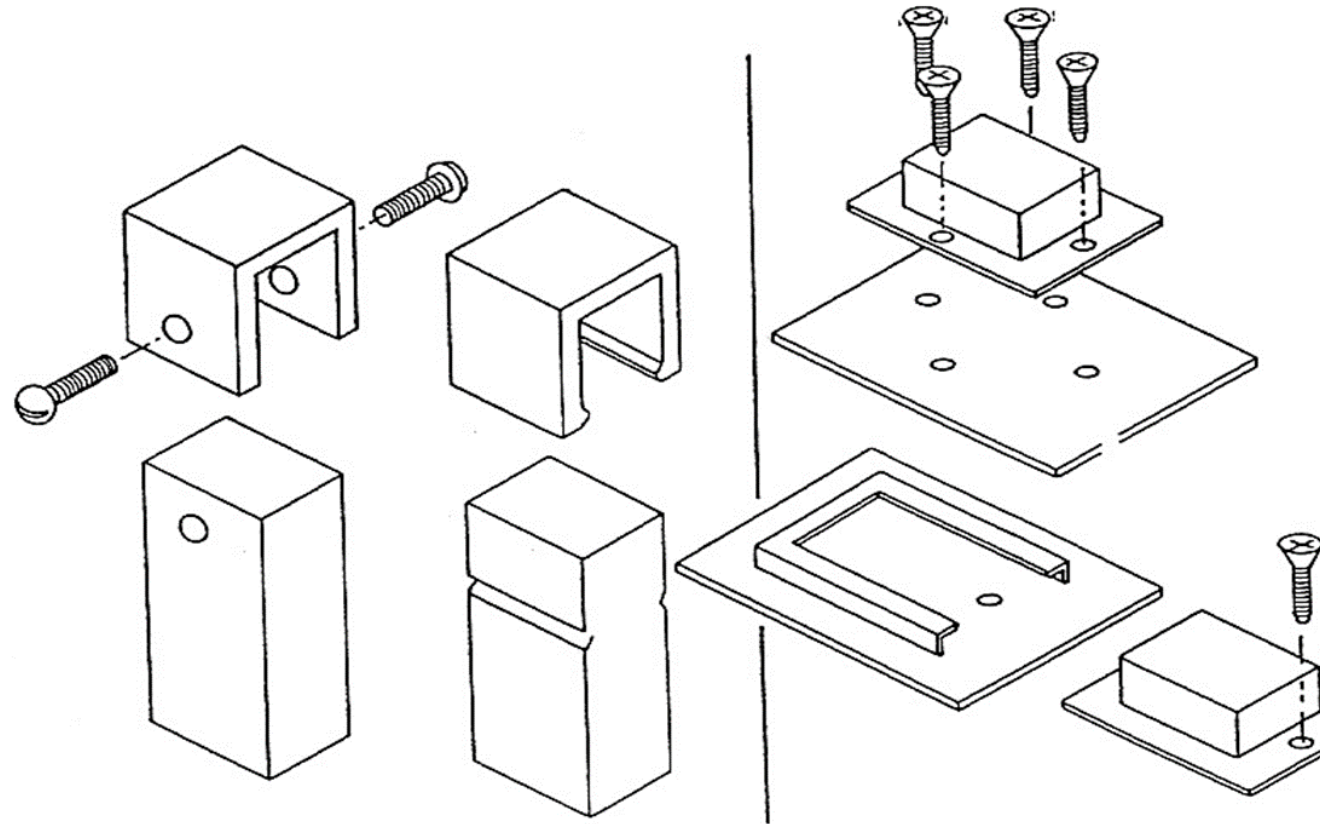
Design for Assembly (DFA) Principles

6. Part is assembled in a
single linear motion



Design for Assembly (DFA) Principles

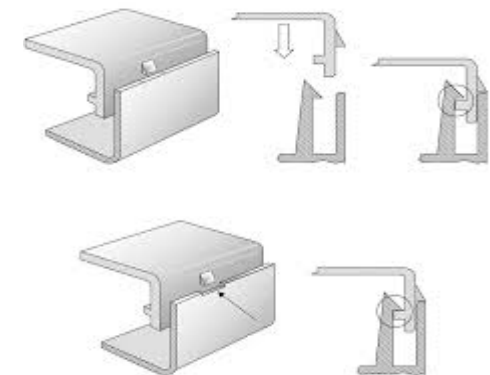
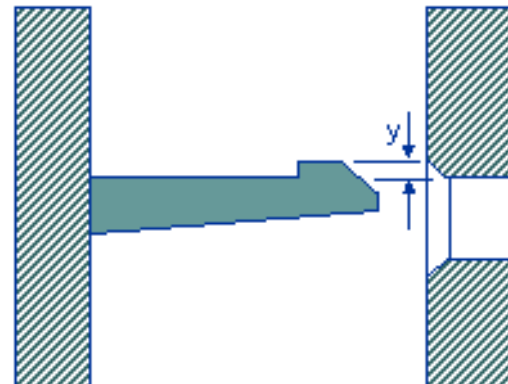
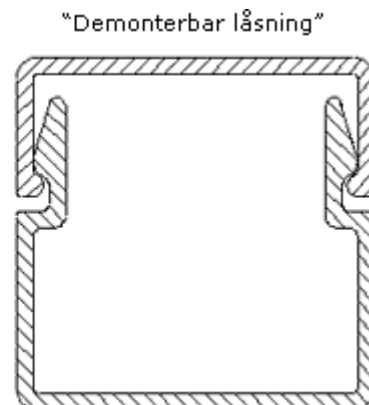
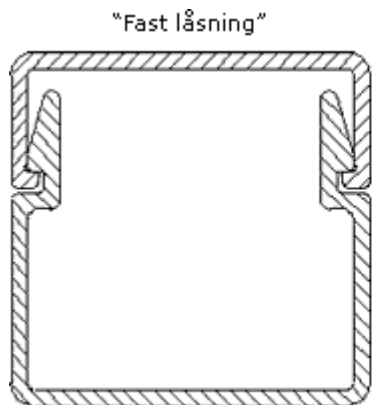
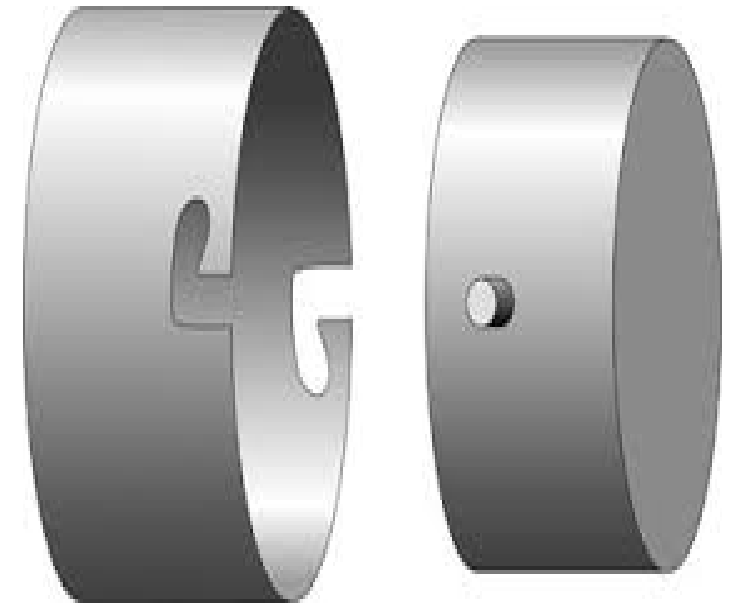
7. Part is secured immediately upon insertion



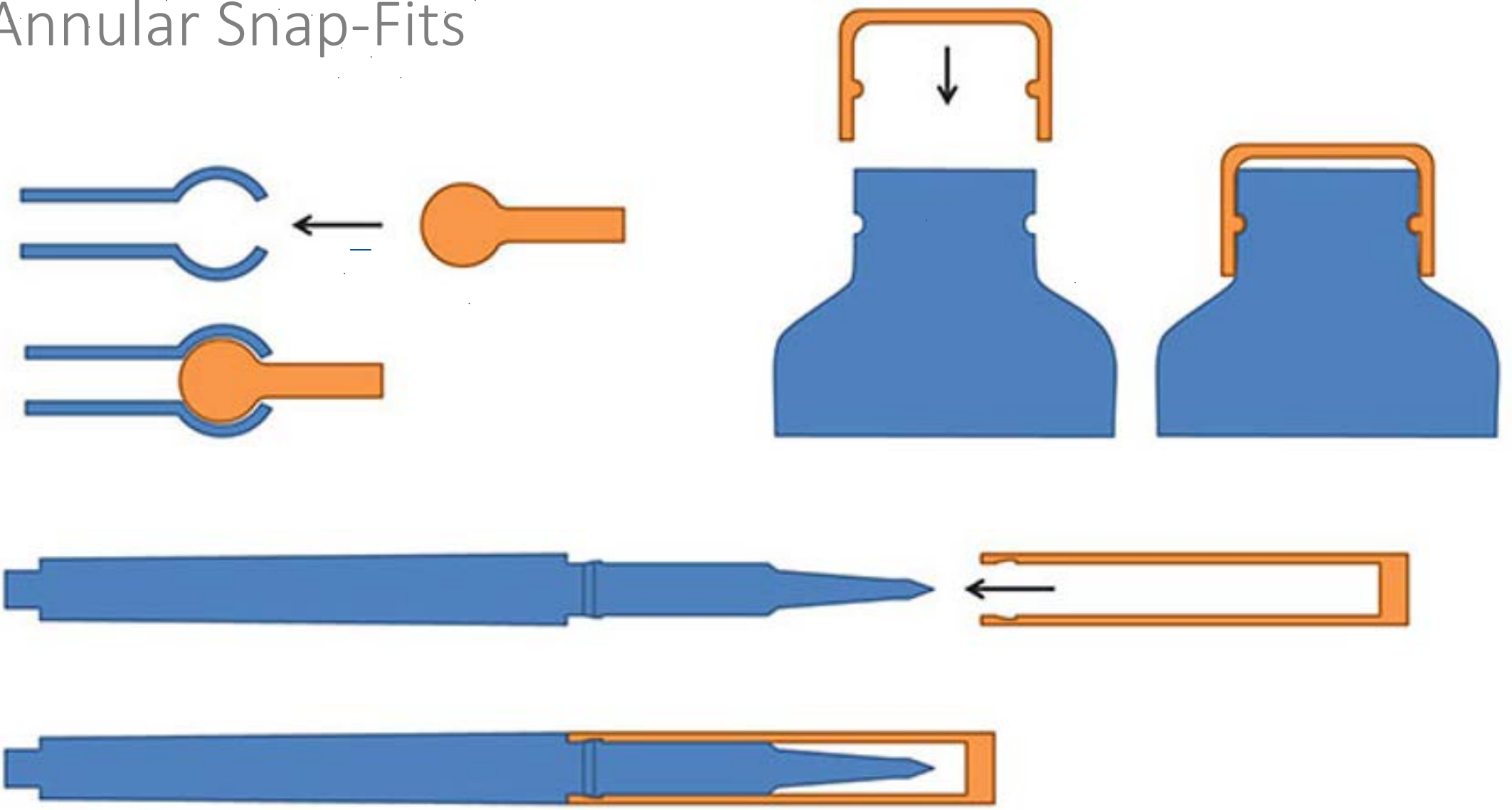
Design for Assembly (DFA) Principles

7. Part is secured immediately upon insertion

Consider hassle free joining fixing methods



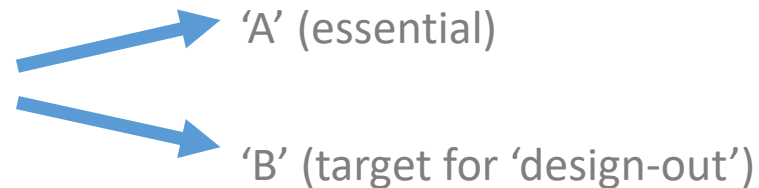
Annular Snap-Fits



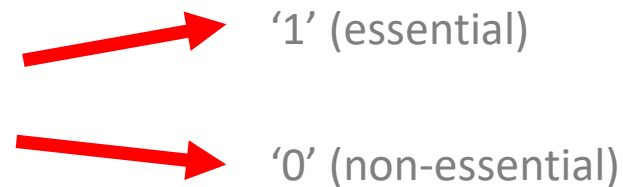
Which parts are “Essential” (DFA)

- Both the Boothroyd & Dewhurst, and Lucas methodologies use the idea of fundamental or essential parts
- All non-essential parts should be evaluated in case they can be designed out

The Lucas methodology



Boothroyd & Dewhurst



Design Efficiency

- Design Efficiency is the number of essential parts divided by the total number of parts, expressed as a percentage.

$$\frac{A}{A + B} \times 100\%$$

- Maybe use Design Efficiency in a decision gate, by specifying a target efficiency percentage.

START

Does this part move relative to all parts which have already been analysed?

Y

Is the movement essential for the product to function?

Y

Must the part be separate to provide the required movement?

Y

It's an "A" PART – essential

N**N****N**

Is this part of a different material to all parts already analysed, with which there was no relative movement?

Y

Is a different material essential for the product to function?

Y

Must the part be separate to satisfy the different material requirement?

Y**N****N****N**

Is the part separate to allow for its in-service adjustment or replacement?

Y

Is the adjustment or replacement essential?

Y

Must the part be separate to enable the adjustment or replacement?

Y**N****N****N**

It's a "B" PART – non-essential

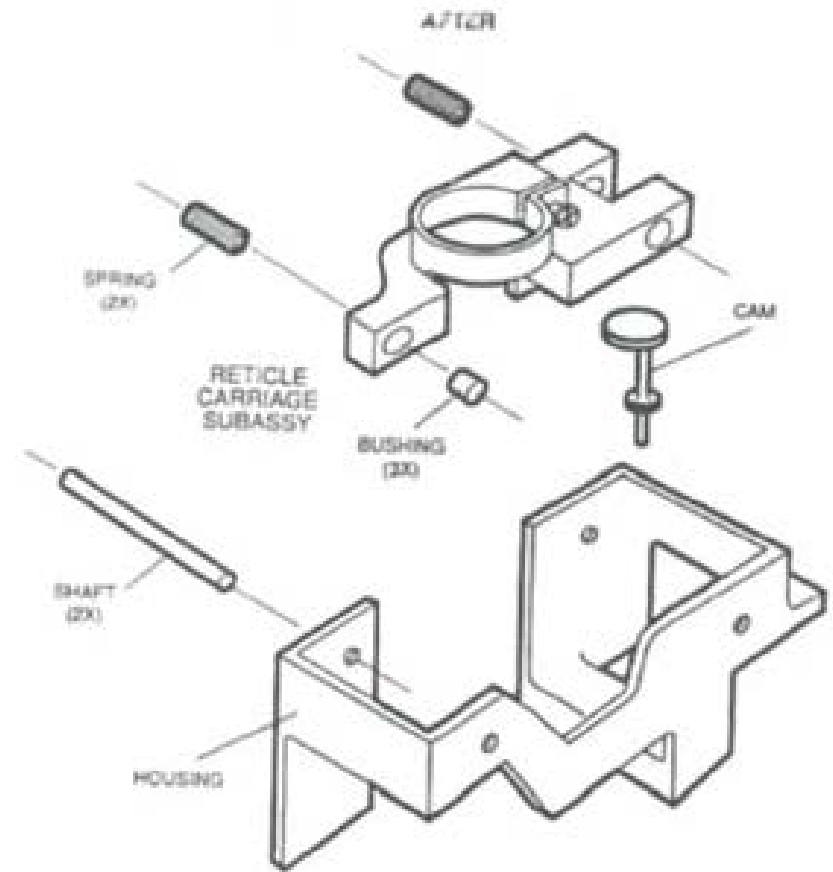
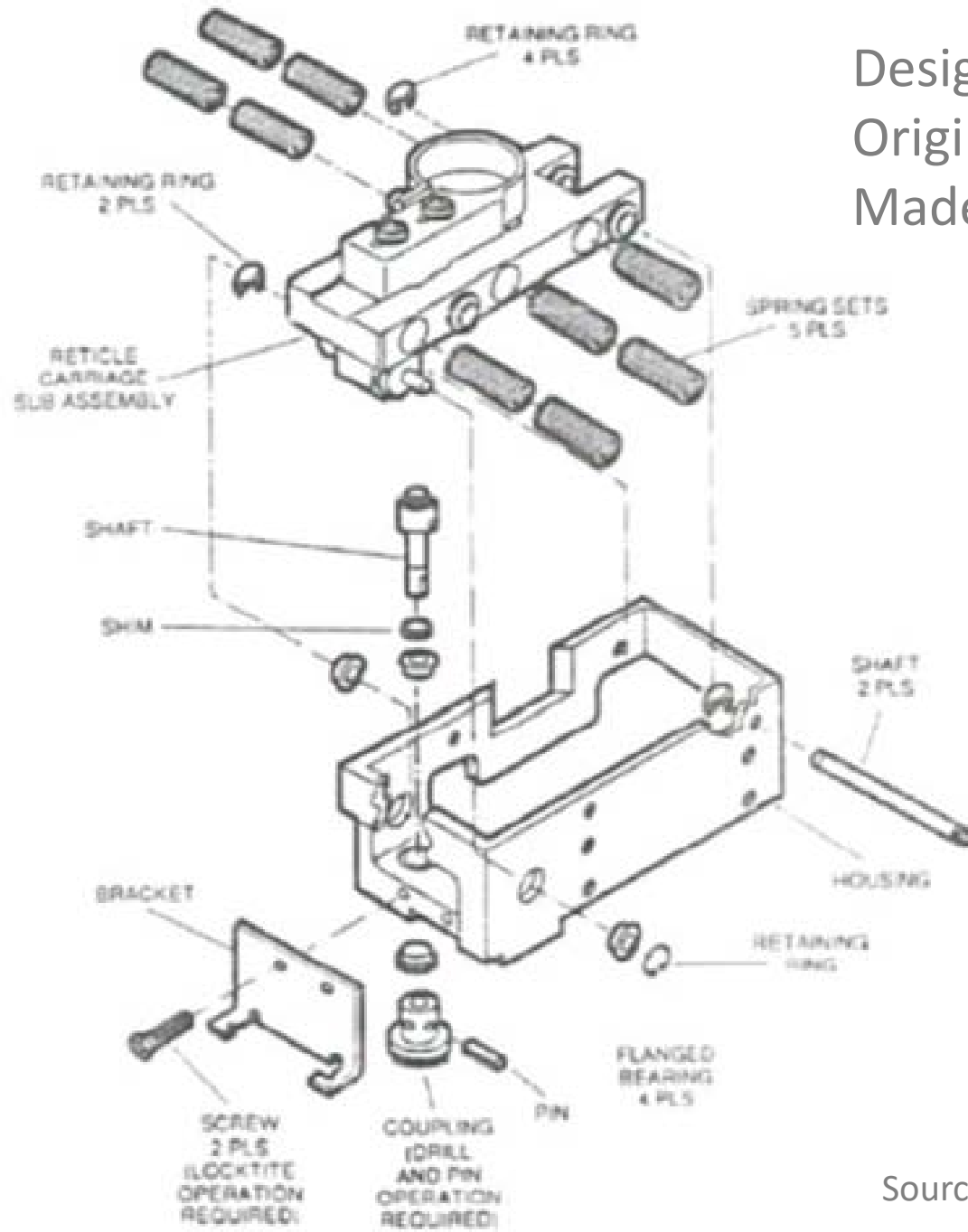
All threaded fasteners are DFA non-essential parts

A study at Ford in the 1990s found that threaded fasteners featured in 75% of assembly line defects.

- Under-Torqued
- Over-Torqued
- Omitted
- Torque Relaxation (NVH)
- Cross Threading
- Incorrect Fastener



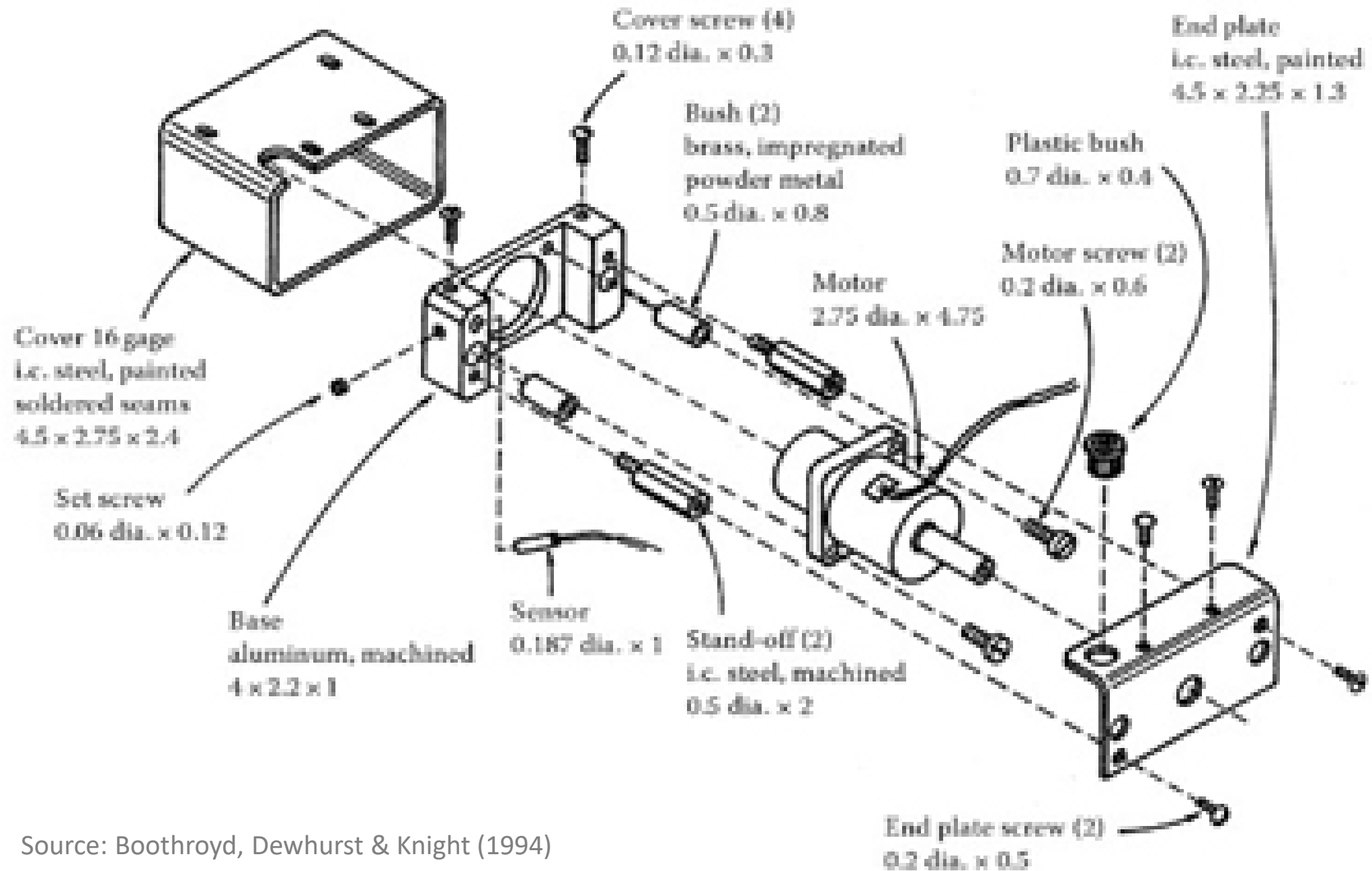
Design for Assembly Example
Original design for gunsight reticle for a US tank,
Made by Texus Instruments Inc.



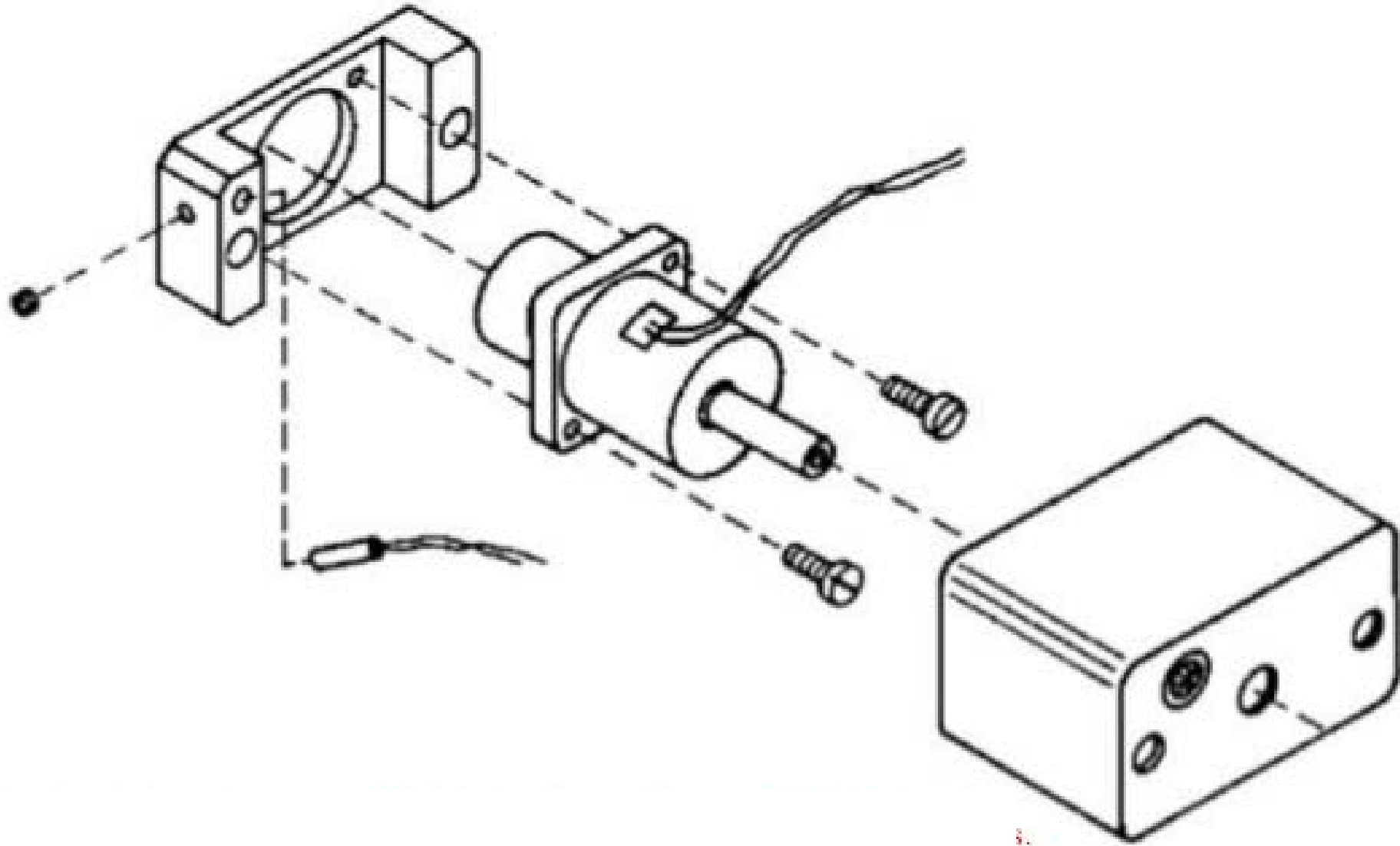
Source: Boothroyd, Dewhurst & Knight (1994)

Measuring Improvement

	Original	Redesign	% Improvement
Assembly time (h)	2.15	0.33	84.7
Number of different parts	24	8	66.7%
Total # of parts	47	12	74.5%
Total # of operations	58	13	77.6%
Metal fabrication time (h)	12.63	3.65	71.1%
Weight (lbs)	0.48	0.26	45.8%



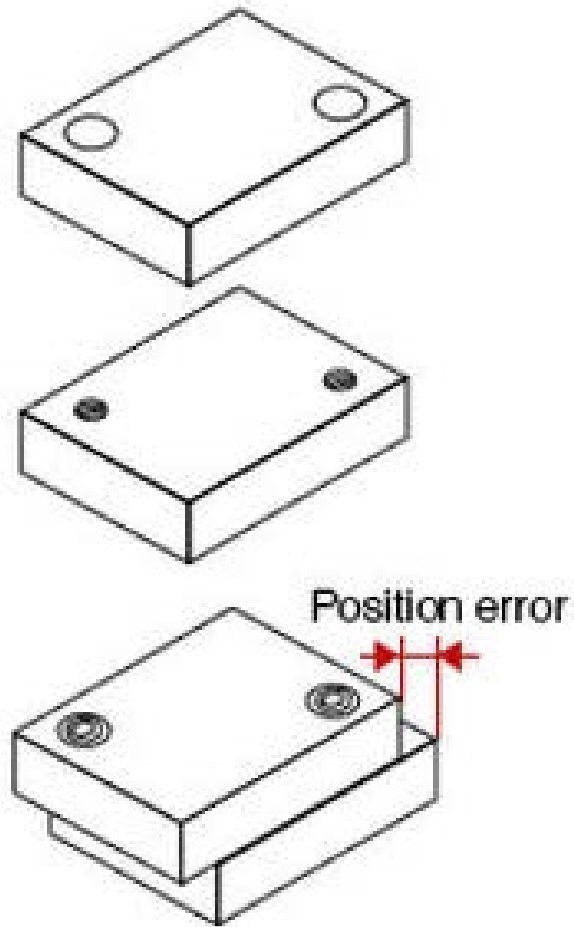
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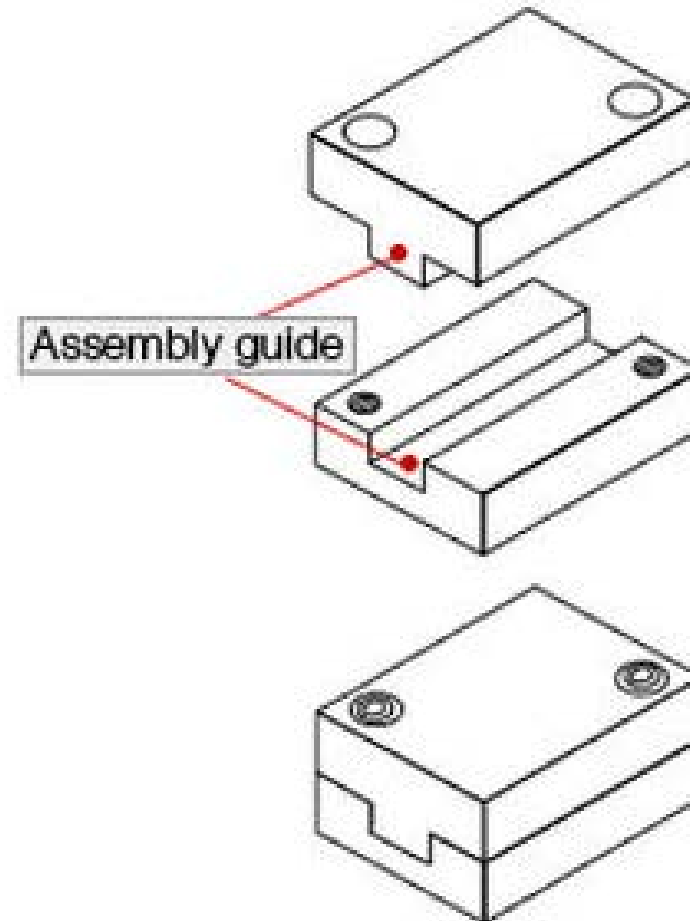
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Use of Location Guides

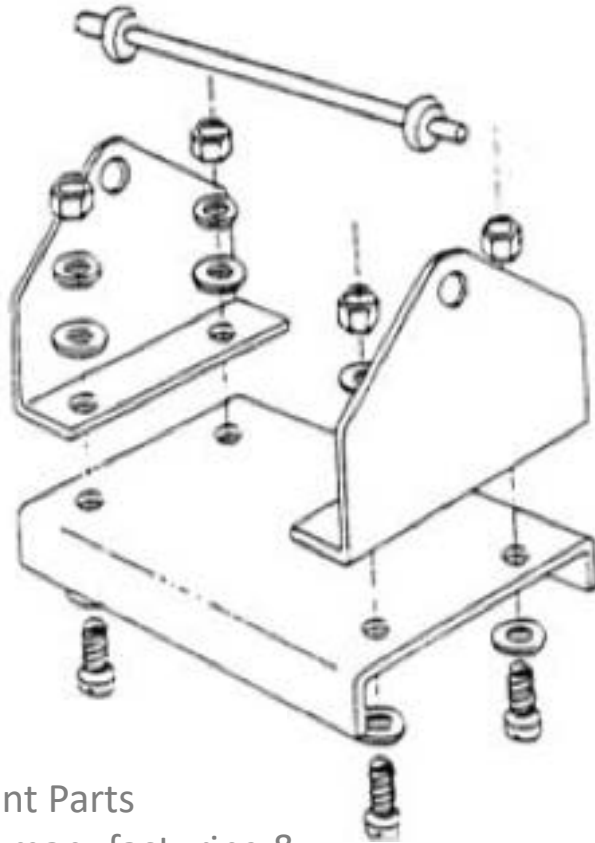
a) Alignment issues in parts with no assembly guides



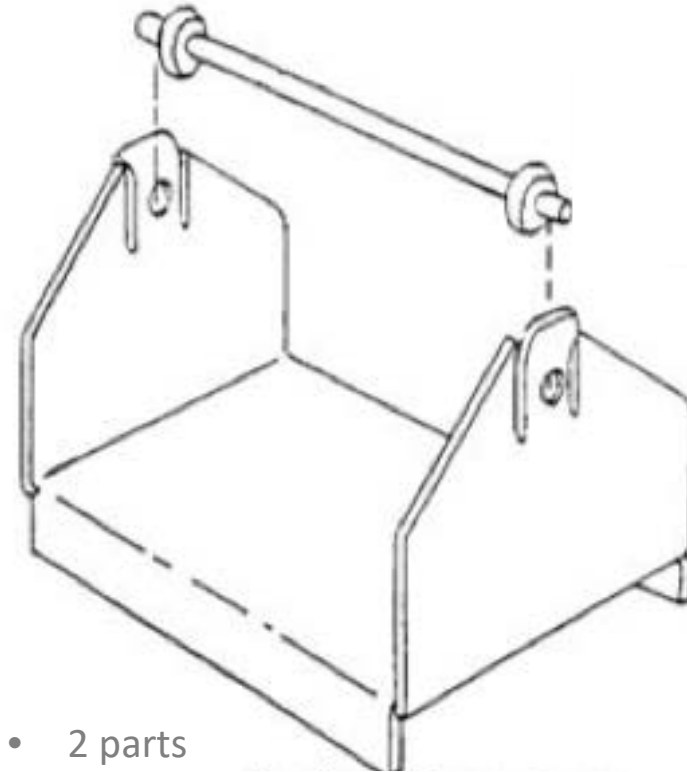
b) In case of parts with assembly guides



Component Elimination: Roll Bar Design



- 24 parts
- 8 Different Parts
- Multiple manufacturing & assembly steps necessary



- 2 parts
- 2 Manufacturing Processes
- 1 Assembly step necessary