

ME349

Engineering Design Projects

Design for Manufacturability

"The key objective in any design for manufacturing effort is to achieve simplicity..."

There are many things which are ...valid measures of simplicity ...

First is the number of parts.

Second is assembly time. (You cannot assemble something in a very short time if it's complex)

Third is the number of processes employed

(And last) ... is the complexity of the process ..."

Fred Schwager, DFM expert

What is Design for Manufacturability (DFM)?

DFM is an approach followed during the design process that has the aim of improving manufacturing productivity. It allows engineers to estimate part and tooling costs based upon:

- Type(s) of material(s) used
- Type(s) of process(es) used
- Part size
- Part complexity
- Supplier operating cost

Designing a product is just the first stage of development, next comes manufacturing the product. Designers should keep up to date with the manufacturing process and the materials and components available. Each process will have its own advantages or limitations in production. Some offer unique properties that may be exploited in a product, while alternatively new components and materials may be available to facilitate product design and assembly.

DFM is often divided into two subdivisions. These subdivisions are:

- DFP - Design for the Process
- DFQ - Design for Quality

In addition, it is intended that DFM be used in conjunction with the DFA process. The user will find that these subdivisions overlap and in fact, sometimes contradict. There always exists an element of trade-off in applying DFM principles.

Some Common Rules of DFM

Simplify and reduce the number of parts. This will minimize the chances of a defective part or an assembly error, while reducing the total cost of fabricating and assembling the product.

Utilize common parts and materials to facilitate design activities, to minimize the amount of inventory in the system and to standardize handling and assembly operations.

Design modular products to facilitate assembly with building block components and sub-assemblies.

Minimize flexible parts and interconnections. Any joints and fasteners should be designed as efficiently as possible.

Foolproof the assembly design so that the assembly process is clear.

Design verifiability into the product and its components to ease the testing or inspecting.

Design for ease of fabrication. For instance, avoid designs requiring sharp corners or points in the cutting tools because they break more easily. Additionally try not to use walls and webs that are too thin or pockets and holes that are too deep. These features can cause a part to distort during the machining process.

Design in the middle of a part's tolerance range. This allows you to avoid tight tolerances beyond the natural capability of the manufacturing processes.

Design "robustness" into products to compensate for uncertainty in the product's manufacturing, testing and use.

Design parts for orientation and handling to minimize unnecessary manual effort, to avoid ambiguity in orienting and merging parts and to facilitate automation. Parts should be designed with surfaces so that they can be easily grasped, then positioned and fastened by either a human or robot. Ideally, all parts should be assembled in one direction.

Design for ease of servicing the product.

Design parts with multiple functions and uses.

Make sure a dialogue is maintained between designers, engineers, manufacturers and any other individuals who play a part in determining final product costs, especially during early stages of design.