Solidworks zen

Design For Assembly and Manufacture

DFX is an acronym for "Designed For X" where "X" is typically "A" (Assembly) or "M" (Manufacturing) This can be thought of as the "lean manufacturing" lingo for describing a machine that was designed for creation. Large machines typically require many people to put them together and problems are much cheaper to solve on the computer before they get to the shop floor.

Designing the machine intelligently will reduce not only headaches but also labor and make everyone happy.

Design for manufacturing refers to the manufacturing portion of the machine creation; welding, machining, etc.

Design for assembly refers to what takes place after the manufacturing portion is finished and typically consists of; fastening, installing gearboxes, putting chain on, etc.

Engineers who haven't been fortunate enough to spend time on the shop or learn about this first hand (it's not taught in universities) tend to struggle in their careers. I have personally had the opportunity to install gearboxes in large machines that didn't take this into consideration and it can mean the difference of 1 person spending 15 minutes or 2 people spending 2 hours with 1 guy trying to position himself perfectly upside down in a machine that didn't take assembly into consideration. It isn't fun and it really hurts the morale of the shop employees.

Things like leaving enough space for installing critical elements and creating subassemblies that aren't too big to move make a big difference.

Great engineers carefully decide what portions should be welded and design modular subassemblies that can be manipulated as easily as possible by the people putting it together. Another benefit of intelligently designed subassemblies is that many people can work on assembling the individual subassemblies same time and won't get in each others way.

I personally feel that each talented designer has his or her own personal philosophy when it comes to DFX, I'll give the gist of ours below.

This builds upon AND is derived from design intent as that is the first step and the last video.

Once design intent is established, design of the machine can begin.

One of the principals I use is **designing things so that they use just enough material**. This fits into my design intent by having regards for the environment, keeping cost down and making it look beautiful. For example, I use bolts that stick out no more than ¼".

When the machine is done, the inventory person can stage all of the hardware before it gets to the assembler. It takes my design intent to an entire new level and makes it easy to see if there is a problem or if hardware is used in the wrong place. For example, I know that if I go out to the shop and see a bolt that sticks out 1", there is a bolt somewhere that is too short.

The goal is to make is so that things are exact and processes must be followed precisely or else problems will arise, this also forces discipline.

I prefer to weld only components that need to be rigid such as a frame as it's easier to correct problems in the future and change parts that wear out.

Whenever designing a dynamic (involving motion) system that hasn't been created before, it's almost inevitable that it won't work the way it is desired the first time and rework will be required. That is why there are revision blocks on the drawing templates.

Sometimes rework is inevitable for reasons outside of anyones control. When designing adjustable parts, some engineers are very sloppy and don't factor into account how much is really needed or design holes too large. When we overdesign, more machine time is required and this is very costly.

Solidworks has advanced mates that allow the designer to see exactly how much adjustment is needed.

In regards to holes, I personally believe they should be oversized 1-2 drill sizes; this allows easy assembly. If they are oversized anymore, this encourages the machinist to be sloppy.

Again, the idea is to **bring the problems to the surface while promoting discipline** and sometimes the problem can be sloppy work. Many designers aren't aware of time and material saving tricks such as using a press-fits. An example of how to use a press fit would be for bearing block. The external bearing block can be bored out to 1/1,000th to 2/1,000th of an inch smaller than the bearing so the bearing can be pressed in easily without requiring any extra hardware or work. Also, putting exactly enough information on the part and assembly drawings allows the part drawings to go to the shop first to be make then inspected before releasing the manufacturing (welding) and assembly drawings.