

Electronics HW Design Process – Manufacturing Process and Supply Chain

Working for a small start-up or a large company can be quite different when it comes to process and the availability of specialized resources, but no matter who does the work, it needs to be done by someone and that someone could be you. If you have resources supporting you in these areas, I would suggest you go and meet them in person (if possible). This is a good time to get to know each other and figure out how best you can work together to ensure the best possible outcome for your project.

I am writing this article before any discussions on detailed design aspects deliberately. It is my belief that before getting into any kind of detailed design a good understanding of and a good relationship with manufacturing and supply chain is paramount. In my experience, being able to secure components and materials in this day and age is a much more critical task than it was 10 or 20 years ago. In the past we never even thought about supply shortages for capacitors and resistors. Today even simple passive components can be difficult to source. COVID-19 puts even more strain on our ability to source supplies and get the parts we may need to move our projects forward.

Component Engineering and Supply Chain

Component engineering is often a function within the supply chain management system, since there are many synergies between supply chain management and component engineering. Understanding how to interact with them will give you the best possible outcome for your project.

A librarian working closely with supply chain management may start with ensuring any components added to libraries (for instance schematic or layout) are implemented in a consistent and meaningful way without errors. Any problems at this level can become quite challenging. Today's components are very dense and packages are often leadless, making it very difficult, if not impossible, to rig up a few working prototypes. Another area where errors can creep in is the 3D representation of each part on your PCB. This will be used to fit the PCBA mechanically into your enclosure, thus errors may lead to interferences not allowing you to fully assemble your prototypes.

Making sure the components you select are available for purchase in desired quantities from reputable suppliers, have good life expectancy (not going end of life or obsolete any time soon), have second sources or footprint compatible alternatives (multiple suppliers / manufacturers / part numbers), do not cause any known issues in the manufacturing process, and parts are of good quality and reliability, are other examples how supply chain management and component engineering will support you.

Tip: Running a Bill of Materials (BoM) scrub in the early design phase is likely going to help you identify any hard to source parts and components with low life expectancy.

Purchasing / Sourcing

Finding materials, parts, components can be quite easy and it can be extremely difficult and time consuming. Even though I can check the inventory of various suppliers online, the data is sometimes false and honestly, I would rather spend my time designing. Relying on a single supplier such as Digikey can be really helpful and it can mislead by giving the impression that sourcing that part is much easier than it will be down the road. Due to cost it is less likely that production can rely on them as a source.

One of the first things I do before starting the detailed design is visit the purchasing person in charge of the project. I let her/him describe to me how best to order components, what forms need to be filled out, what the overall process is. In the past this has saved me a tremendous amount of time. Due to having a good rapport with the purchasing person I often ended up asking for what I needed and the parts landing in my lap a few days later. How easy is that!

Relying on brokers for your supply of materials or components is a bad idea. The cost will be multiple times what the actual market price is. With the online market as it exists today, some online brokers and suppliers are less than reputable and you take a risk receiving non-functioning or fake parts.

Quality

Understanding your company's process around quality and your direct influence on the quality of your product and its components is important. While quality has many aspects outside of manufacturing and supply chain, existing processes have been developed over periods of time and are likely in place to provide the best possible product quality. You as the designer have a great responsibility, since you lock in the product quality through your design including component selection and layout.

Manufacturing

The primary purpose of manufacturing is to build your product. You may have more than one manufacturer. Your mechanical components may be manufactured by someone other than your bare PCB or your PCBA and product assembly. It is typically a good idea to involve all of your manufacturers at some point in the design process to help you make the best decisions. By not doing so you run the risk of missing out on their contribution. If you can, visit them and get to know the people you will be interfacing with.

Manufacturing is process driven. Deviations from existing processes will require some form of process development and verification. Thus, it is useful to discuss the design intent and the design details as soon as available with manufacturing. It includes electronic components, PCB design and layout, mechanical components, product assembly as well as packaging, distribution, and shipping. This allows the manufacturer to influence design choices and/or start any process development on their end right away.

If, for instance, capacitors are placed too close to the edge of the PCB, the design may still work, but manufacturing will likely have issues with broken capacitors due to the mechanical stresses on the PCBA when separating individual boards from the main panel. Another example would be SMT component placement close to through-hole components to be assembled using some form of wave soldering. Issues can easily be avoided by making manufacturing engineers part of the design process.

Tip: Many Contract Manufacturers (CMs) have readily available documentation and design guidelines answering many of the questions you may have.

In most companies I worked for, the bare PCB stack-up was developed very closely with the primary supplier. This was to ensure we would get the right performance at the best cost possible within their technical abilities. Sometimes a product requires specific technologies as for instance laser drilled vias. Not all bare PCB suppliers will have that technology and understanding the impact of the use of specialized technologies on your cost and your supply chain needs to be understood.

Chances are your product and PCBA assembler will take over all sourcing of materials, parts, and components in the future. They may also test your product and provide additional services such as repair and rework. Understanding and involving their engineering teams early can be highly beneficial to include their knowledge and experience into your design right away. This may save you from having to design several revisions of your product. Simple things such as leaving sufficient space around a component for rework tooling may be worth considering. Other examples of areas to involve your manufacturing may include

- PCBA and product test strategies
- placement/design of test points
- additional test access (for instance JTAG)
- the ability to program components
- placement of component
- mixed through-hole and surface mount technology
- maximizing yield

Depending on the markets you are developing the product for, your manufacturer(s) will need to influence design aspects more or less. High volume and/or low-cost products usually need a much higher degree of manufacturing involvement, since your product will have to be optimized for manufacturing processes to be able to support the higher volumes and the lower cost.