Full E-course

15 STEPS TO DEVELOP YOUR NEW ELECTRONIC HARDWAREPRODUCT

HARDWARE ACADEMY

STEP 1

Define your product based on your market research

The first step in developing a new product is to define the details of the product based on the market research you've done.

The more details you specify the more likely you are to end up with the product you want, or more importantly the product that customers want.

Below are some examples of what you should include in your product definition:

Purpose of your product

Describe the overall purpose for the product. Who will use it, where will they use it, and why will they use it.

Summary of features

List all desired features with a brief summary of their intended purpose. When possible try to differentiate between hardware features and software features.

Target retail cost

Knowing your target retail price gives your development team some idea on the components that can be used. If you plan to sell your product for $10, then the component choices will be considerably different than for a $500 product.

Product dimensions

Small size is extremely important for a lot of modern tech products, but keep in mind that squeezing everything tighter will increase your development complexity.

Operating environment

Will your product be used in extreme environments such as in subzero temperatures? Then that will be very important for the design, so be sure to describe the intended operating environment for your product.

Battery requirements

How important is battery life for your product? Will your product have a rechargeable battery? If so, how will it be recharged (USB, solar, wireless, etc.). What are the physical constraints on the battery size? These are all details you should specify.

Mobile app requirements

Does your product need to communicate with smart phones? Does it need a custom app? If so, will it be for Android, iPhone, or both? Describe in detail the features required for your mobile app.

Processing performance

Will your product process lots of data or perform complicated calculations quickly? Or perhaps your product has an advanced user interface with complex graphics? This will impact the decision on the best microprocessor or microcontroller for your project.

STEP 2 Look at the big picture – Know what lies ahead

Most entrepreneurs dive head first into all of the details of fully developing their product. Only after they finally finish development do they finally look up and begin trying to market it.

This is a huge mistake! To have a realistic chance at success you absolutely must understand all of the *costs* and *obstacles* you must surpass to get your product to market.

The types of questions you need to address include:

How much will the product cost to develop?

Development costs will be your first major financial obstacle. Development costs for most hardware products are broken down into two categories: the electronics and the enclosure (and other mechanical parts).

Whether you plan to bootstrap product development or raise outside funding you need an accurate estimate of how much money you will need. Otherwise you may run out of money before your product is fully developed.

How much will it cost to scale to mass manufacturing?

The electronics is usually the most complicated piece to develop, but the enclosure (and any other custom plastic pieces) is usually the most expensive and complex part of the product to scale to mass manufacturing. This is primarily due to the cost of the high pressure injection molds required to produce custom plastic parts.

The primary scaling cost for the electronics are the required electrical certifications such as FCC, UL, CSA, CE, RoHS, etc. Obtaining these certifications is not cheap so be sure to plan ahead for these costs. Fortunately, there are ways to significantly reduce these costs.

How much will it cost to manufacture the product?

It's critical to know as soon as possible how much it will cost to manufacture your product. The worst-case scenario is you spend your life savings developing a product that can not ever be manufactured and sold at a reasonable profit. But that's a gamble many entrepreneurs take.

Don't spend thousands of dollars creating a new product until you know how much it will cost to develop, scale, and most importantly, to manufacture.

There's a lot that goes into the manufacturing cost for an electronic hardware product. Some of these costs include the electronic components, the PCB, the enclosure, product assembly, quality testing, manufacturer's profit, scrap, duties, and logistics.

The only way to accurately estimate the final manufacturing cost for a new product is to first develop a *preliminary design* of the product. This preliminary design (or *pre-design*) is focused on developing the product just enough to estimate the final manufacturing cost.

Does Apple (or any successful tech company) start developing a new product without knowing how much it will cost to manufacture it? Of course not, and neither should you!

STEP 3 Formulate your plan

Developing, scaling, and eventually manufacturing a new electronic hardware product is no easy task. It takes tremendous focus and hard work. But it also takes planning. Developing and manufacturing a new product is too complicated to just "wing it".

You need a plan to succeed. Don't make the mistake of jumping head first into product development without a realistic plan.

I don't necessarily mean you need a formal business plan (unless you plan to raise outside capital), but you must at least have a realistic plan to surpass all of the costs and obstacles you identified in step two.

From step two you should now know how much money is needed to develop your product, scale it, and to purchase your initial inventory.

You now need to formulate a plan on how you will pay these expenses. Do you plan to entirely boot-strap your startup, or do you plan to seek outside funding?

What about marketing, how do you plan to get the word about your product? Will you focus on online or offline marketing?

How do you plan to sell the product? Will you sell it only through your own website, or will you sell it through retail stores, or perhaps through online retailers like Amazon?

These are all things you need to think about and plan for upfront.

STEP 4 Pick your development strategy and team

There are five options when it comes to developing a new product:

Option #1 - Do the product design yourself

You'll need to be experienced with electronics design, programming, 3D modeling, and manufacturing. In most cases, you may have one or two of these skills, but will likely need to outsource some of the other steps.

Option #2 - Find an engineer to become a co-founder

Bringing on co-founders can be a great option if you lack the necessary technical skills or lack the money needed to hire outside engineers.

But finding good co-founders can be very challenging. You will be tied to them for years, so make sure they are a good fit. Also bringing on co-founders reduces your equity in the company.

Option #3 - Hire freelance engineers

Keep in mind that very few engineers will be knowledgeable in electronics circuit design, programming, 3D design, injection molding, and design for manufacturing (DFM) so you will likely need more than one engineer.

You will also to manage the various engineers to make sure all of the pieces fit together properly to form your final product.

Option #4 - Hire a full design firm

The main advantage of hiring a full design firm is that all of the engineers work together and the firm will fully manage the project.

If you lack the skills necessary to manage various freelance engineers then hiring a full design firm may be a better option. The big downside though is that hiring a design firm to your develop your product is the most expensive route.

Option #5 - Partner with a manufacturer

If you can find a manufacturer already making something similar to your own product, they may be able to develop your product.

The downside is such manufacturers are very hard to find, and they likely will want an exclusive manufacturing agreement.

Design schematic circuit diagram for the electronics

Once you have confirmed that you can manufacture and sell your product at a profit, and you have a plan to surpass all the obstacles that lie ahead, it's now time to design the schematic circuit diagram.

A schematic circuit is a conceptual diagram of the electronics that is similar to a blueprint for a house. The schematic circuit diagram shows exactly how all of the components, from microchips to resistors, connect together.

You should have already selected all of the critical components as part of the preliminary design you created in step two. These components will now be connected together in the schematic circuit diagram.

Most designers select the components while developing the schematic diagram, but it is much better to do that as part of your preliminary design step. Doing so is key to being to estimate your product's manufacturing cost upfront before you begin full development and prototyping.

STEP 6 Generate the Bill of Materials (BOM) for the electronics

Once the schematic diagram is finalized then a Bill of Materials (BOM) should be generated. The BOM lists the part number, quantity, manufacturer, and package for all of the electronic components.

Although you should have put together a preliminary BOM as part of the pre-design stage, now it's time to create the final BOM which includes even minor components like resistors and capacitors.

STEP 7 Design the Printed Circuit Board (PCB) for the electronics

Once the schematic circuit diagram is completed it's time to design the actual *Printed Circuit Board (PCB)*. The PCB is the physical board that holds and connects all of the electronic components. PCBs are usually always green, but sometimes red.

A PCB is made up of stacked layers for routing the electrical signals. The simplest PCB uses just two layers. More complicated designs need more layers to connect everything together. Components can be mounted on one side or both sides of the PCB.

STEP 8 Develop the electronics firmware and software

Just about all modern electronic products include a microchip called a microcontroller or microprocessor that acts as the "brains" for the product.

The microcontroller or microprocessor needs to be programmed to perform the desired functionality. This program is embedded inside your product and is called *firmware.*

Many products will also require either a custom mobile application or computer software program.

STEP 9 Design 3D computer model for the product's enclosure

The first step in developing your product's enclosure is the creation of a 3D computer model. The 3D model can then be turned into a physical prototype, and eventually into a manufacturable version of your product's enclosure.

The 3D model can also be used for marketing purposes, especially before you have functional prototypes available.

One of the most critical aspects of designing the 3D model for your enclosure is a solid understanding of the principles and limitations of high-pressure injection molding.

Many 3D designers have no understanding of injection molding, meaning you are likely to end up with a design that can perhaps be prototyped, but not mass manufactured.

STEP 10 Get independent design reviews for electronics & enclosure

All engineers are human (shocking, I know!) and we all make mistakes, so getting a second opinion before prototyping your product is always a smart move that will ultimately save you money and time. In product development, second opinions are called design reviews.

When it comes to anything complex and critical a second opinion is always smart. Whether it's a doctor saying you need brain surgery, or an engineer designing your new product, you would be wise to get a second opinion. Big tech companies always do this and so should you.

STEP 11 Prototype PCB for the electronics

Producing PCB prototypes is a two-step process. The first step is the manufacture of the empty printed circuit boards. The second step is soldering all of the electronic components onto the board. Many times these steps are performed by two different companies.

I never recommend trying to hand solder your own PCB prototypes. That may be okay for very simple DIY projects, but not for more complex commercial products.

STEP 12 Prototype your product's enclosure

You may consider purchasing a 3D printer, especially if you think you will need several iterations to get your enclosure right. If the appearance of your enclosure is critical then purchasing your own 3D printer is likely a good investment.

3D printers can be purchased now for only a few hundred dollars allowing you to create as many prototype versions as desired.

Otherwise, there are many companies at your disposal that will happily turn your 3D model into a real prototype.

STEP 13 Evaluate the PCB prototypes, revise as needed

The first version of any new product is almost never the final one, so any issues with the electronics will need to be debugged and fixed for the next prototype iteration.

This can be a difficult stage to forecast in both terms of cost and time. Any bugs found are of course unexpected, so it can take some time to figure out the source of these bugs and how best to fix them.

STEP 14 Evaluate the enclosure prototypes, revise as needed

Now it’s time to evaluate the enclosure prototypes and modify the 3D model as necessary. Generally it will take several prototype iterations to get the enclosure design just right.

Although 3D computer models allow you to visualize the case, nothing compares to holding a real prototype in your hand. There will almost certainly be both functional and cosmetic changes you’ll want to make once you have your first real prototype.

STEP 15 Get required certifications (FCC, UL, CSA, CE, RoHS, etc.)

Almost all electronic products sold must have various types of certification. The certifications required vary depending on the product and the country the product will be sold in. Some of the more common certifications required include: FCC, UL, CSA, CE, and RoHS.

Fortunately, there are various ways to avoid the need for some of the more expensive certifications.