The Ultimate Guide To Bootstrapping A Hardware Startup

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Say hello @adambenzion

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Got a great hardware idea you really want to bring to life? Not sure where to start? You came to the right place. This guidebook is a tool built just for you. It aims to help and encourage hardware entrepreneurs with the resources, processes and tips to help you build something out of nothing. It's a collection of knowledge from seasoned engineers, hardware hackers, manufacturing experts, supply chain pros and proven entrepreneurs from the likes of XBOX, Kindle, Life Proof, Moment, OtterBox, TI, Bolt, HAXLR8R, and Apple. These are colleagues, LinkedIn contacts, and close friends who were kind enough to contribute to this resource as a way to give all hardware startups and their people a supportive boost.

Ready to start?

In the mental model I now use for starting your hardware endeavors, there are 5 "gates" to pass through:

This guidebook accompanies each gate with a series of specific questions resources and advice. My goal is to help you deliver a hardware product with the least amount of missteps, back-pedaling, and pain. So go on and give FitBit, Nest, and Apple the run for their money. Not only can you do it, the world needs you to do it.

Gate 1

Explore

Let's get started. Before a single nut is connected to a bolt, there is an idea, and with it, many questions must be answered.

This is not a moment to overwhelm yourself with the details–there will be plenty of time for that later–but it's also not the time to start playing with prototypes.

You will be better off in the long run if you make your way through the list to follow and see what you come up with.

Define your customer segment

- What problem are you solving? Whose needs will be served by your product? Would you buy this product? What will the product cost at retail, and is that in line with customer expectations? How big is your market? Build a Marketing Requirement Document.

- What does your brand stand for? This is not the same thing as a company name, logo or tagline, but what you represent. Brand identity is a huge part of today's marketing world.

- There are customer needs, and customer wants. The question your product answers may be mundane, but that doesn't mean you can't make it sexy. Test your idea's seduction power with Google Ad Words hitting your "future website".

- By the way, it's probably never too early for Intellectual Property and trademark consultation, just for peace of mind.

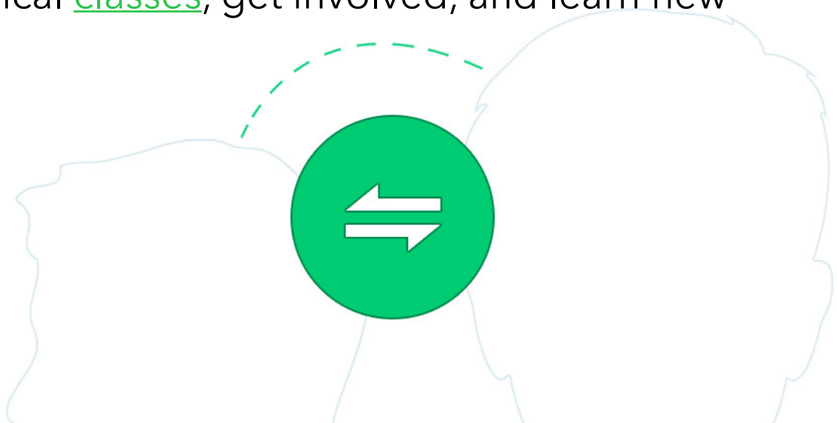
Involve others whenever possible

- Find mentors and advisors. Tap people who you trust. Whenever you can, talk to people who have done this before.

- Validate assumptions: Talk to at least 20 strangers about your product. Gauge their enthusiasm, listen carefully to their questions and don't assume you have the answers yet.

- Build the right team. Yes, you need a skilled team, but an entrepreneurial startup has to be stocked with risk takers. Look for resilient, persevering types who can keep each other motivated when frustration levels are high.

- Take technical classes, get involved, and learn new things.

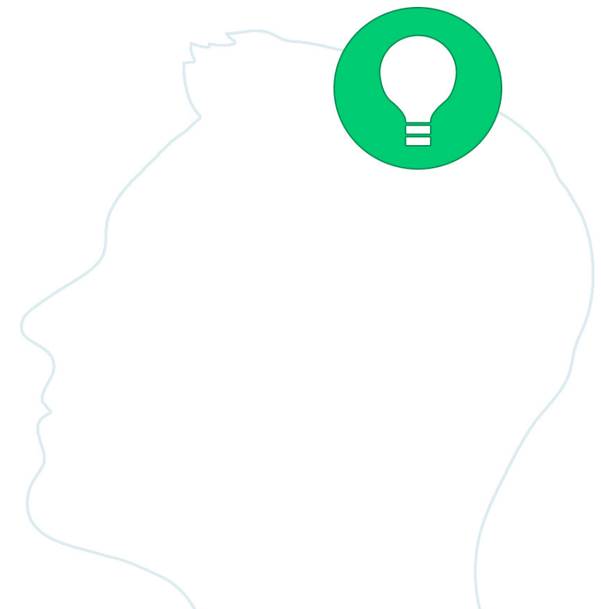


"There are really two factors at play here: what I call “microeconomics” and ”macroeconomics”. Microeconomics is things like your Bill of Materials (BOM) and Cost of Goods Sold (COGS). Own these numbers. Know that every penny counts. Consumer products typically see a 3-4x increase to the shelf cost (ie. a microprocessor that costs you $1 more means the end price of the product needs to be raised by $3 – $4).”

Ben Einstein, Bolt.

Cost is key, figure it out early

- Create cost estimates: Prototypes are expensive and so are the engineers who build them. At this point, a full Bill of Materials will not exist, but accurate cost estimation is still important.
- Map your funding strategy. Cash flow is often the thing that makes or breaks hardware startups. A funding strategy can take many forms, (and of course will be considered more thoroughly when we get to “Fund”), but it needs to be on the table as early as possible.
- Grandiose products, even at this early stage, will come back to bite you later if you can’t command top dollars when you sell them. Margins are business killers. I felt it first hand and it was ugly. It’s never too early to think about costs.



Build an *experience*, not a product

- You are committing to deliver a physical product, and although we aren't at "Proto-type" just yet (that's next), this is the time to sharpen your drafting pencils and contact with the outside world that will help you define the experience you need to deliver in order to succeed.

- Develop visual concepts of software, hardware and people coming together in several use case scenarios. Make them pretty, 3D renders, these are like ecstasy for the soul and they keep you going to keep you inspired.

- Define your product and experience architecture: Design is nice, but what happens under the hood is more important, and as why people would bother to use it and how it translates to everyday use.

- Define your so tware strategy. Be mindful of the Internet of things, APIs. Will you need to consider interoperability with other devices? Probably yes, so how does that work? How does it look like?

- Engaging a professional team to help you build the product? Do it after you've de-fined the co e of you invention, the desired experience, and brand.

- Over-communicate with your team and vendors; insist on "return on experience."

We're sketching the big picture here. Keep track of your answers and ideas as they change over time, and get ready to focus on the next gate: **Prototype**.

Your Exploring Gate Resources:

Map your business strategy with a business model canvas

Access market research from CEA

Build a cool "coming soon" website to test your SEO seduction power

Join a Startup Weekend and validate your idea

Find great people on Angel List

Get a badass domain with a ton of options and dot.hacks

Tap product ideation and design firms: Teague, Anvil Studios, Whipsaw, Smart Design

Get to know the good people, programs and resources at Up

Read:

Steve Blank's tools for startups

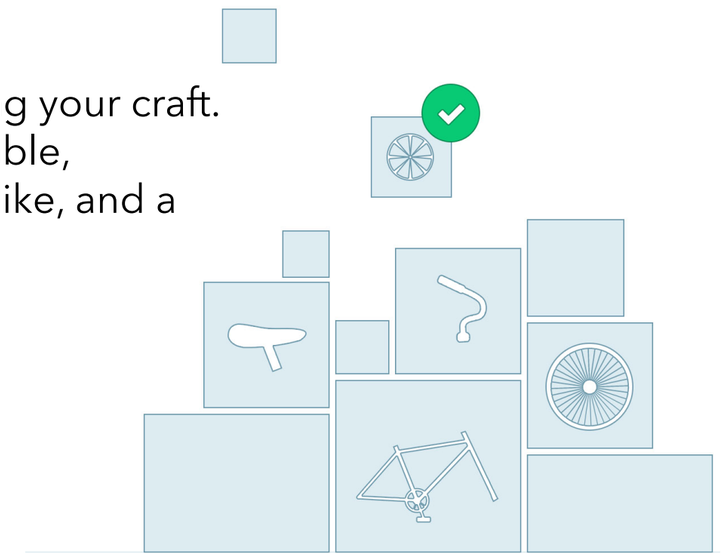
Gate 2

Prototype

Your early prototypes may not look like much. Your minimally viable products (MVPs) will likely be made from duct tape and scrap wood, and you'll probably destroy kitchen knives and scissors cutting plastic and metal before super-gluing it all together. It's hard to believe that these prototypes may one day get translated into the final p oduct, but this is how you start. I built sad little prototypes from parts I ordered from Alibaba.com before I met my co-founder.

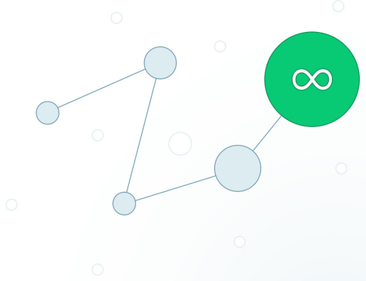
When I joined OtterBox, a billion dollar business, I had the luxury to build amazingly fun and complex prototypes incorporating appearance models, Bluetooth Low Energy (BLE) and GPS radios, iOS and Android apps, cloud, analytics and lots of fun RGB LEDs. It was rapid and the team was world class - that was the dream, almost limitless. The reality for a startup begins with duct tape and Arduino boards and is anything but limitless. But don't be afraid to dream big about the performance and appearance of your final p od-uct; a little daydreaming and imagination can fuel a self-fulfilling prophecy, at the worst, it will keep you motivated.

The Prototype gate is often both fun and frustrating as you start understanding and developing your craft. Enjoy the excitement but be prepared for setbacks. You exit this phase when you have a reliable, working prototype, some high-quality visuals of what you think the finished product will look like, and a list of the key hardware components.



Process

- By now you should have a product requirement document. Refer to it often: What it is you are building, exactly? Discipline yourself to use this document as a guide. If your product starts to change radically, that's fine but that might mean a trip back to the Explore phase.
- It's all process right now: Iterate, learn, improve, learn, optimize, and learn.
- When you finish your first prototype, start working on your second, and third. Think in terms of success metrics: It's not how many prototypes, but what is the bar for the final one? And before that: What is the bar right now, for the next build?
- Test for manufacturability. A good rule of thumb: By the time you reach your 3rd prototype, you should be starting to verify that it is actually buildable.



Hardware

- Build it at home first: Order products from Alibaba.com and other inexpensive suppliers, and stock up on ducttape.
- Electronics: Start with kits, then breadboards, then custom PCBs, and not the other way around. And if you have electronics in your product, expect to have more before it's all over.
- Identify important components and hard-to-find ones keep track of reliable suppliers. An early relationship with Avnet will go a long way.
- If batteries are part of the picture, think carefully about your requirements. Looking for a Lithium-ion battery? Do yourself a HUGE favor: Source a pre-certified battery and save yourself a lot of time and cost.
- If you can't find the pa t you need, you can probably make it! 3D Printers are now easily available around the world. Find a local shop and make some friends.
- Identify prototyping partners who can help you build and test your first.
- This is also the time to start understanding consumer electronics regu-lations and certifications.
- Looking to get inspired? A personal favorite video blog and store you have to check out when you start building is Adafruit.

"To succeed, hardware needs software that makes it sing."

Adam MacBeth

Software

- Create software experiences that engage users intelligently. I used a firm in NYC called Fueled that really understood how human experiences related to mobile power management, by delivering smart and engaging, hardware connected experiences like never seen before.

- Leveraging software to better understand your users through embedded analytics like MixPanel. Hardware alone is a box. Hardware with software is a blackbox.

- Use software to fix upgrade, and evolve your hardware through remote firmware and software upgrades.

- Learn more about products or approaches that make it easier to connect things to the Internet of other things. Like Swarm from Buglabs.

Stay forward-looking, but hold on to your past. Please keep your first p oto-types. As souvenirs, these mementos will mean more than you know later on when you become the next Samsung. They are your first-born the something you made from nothing. Not to men-tion: You never know when you might go back to those early prototypes for a fresh reminder of your original vision.

If you make it through this gate, with ready prototypes in hand, you've come a long way. But the two most critical gates in building hardware startups are still ahead: Fund and Manufacture.

Must Read:

Marc Barros' hardware blog

Your Prototyping Gate Resources:

Order gadgets, take 'em apart, and duct tape - Alibaba

Make friends with open source hardware like Arduino and OSHWAS

Find a 3D printing shop

Make friends with your components distribution partner

Learn how to certify your products

Somebody at your startup should be solid with Solidworks

Kits! Affordable, low cost development kits from TI

Free 3D CAD library – WOOT!

A Great place to start learning about IP

Phabricator, an open source, software engineering platform

The CAD giant that never goes out of style Autodesk

Product development partners: Synapse, Nytec, Carbon Design Group

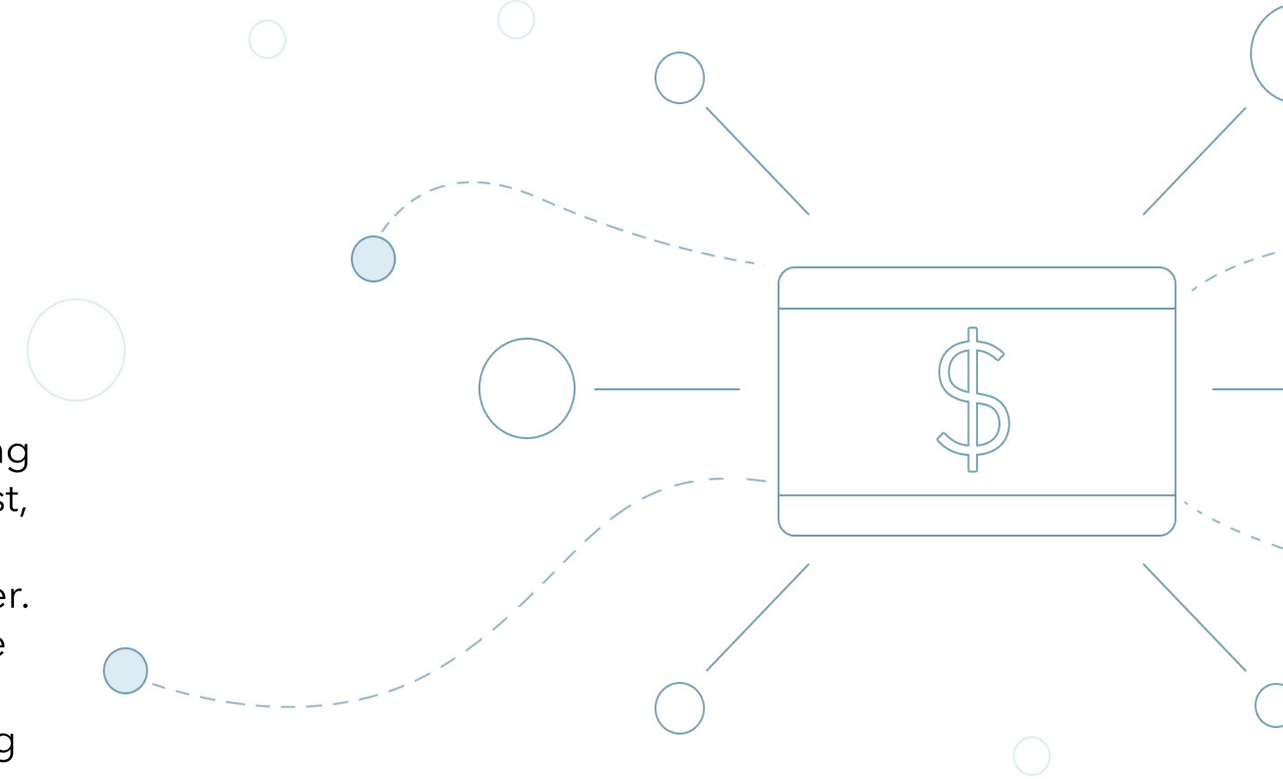
Get to know this company sooner than later: Dragon Innovation. Indispensable!

Design, compile, and simulate your project electronic online at 123D Circuits

Search engine for components? Yes it exists: Octopart

Gate 3

Fund



The bottom line is that you can only raise money with something physical, something built. A PowerPoint may raise some interest, but getting your prototype built is a rite of passage, a passage to cash. And as far as funding is concerned, the more the better. That probably seems obvious, but I've said it before: Hardware is fairly expensive to build and experiment with. You will need around $20K to play with plastics only, $40K to build something that has more mechanical parts or optics, and around $80K to build a serious consumer electronics prototype. I truly believe that these numbers are the bases, a minimum and not an average. And on that note not all money is equal. If you can, find a future customer that will fund your first o der, and only then try Crowdfunding and venture or debt financing

Speaking of Crowdfunding, it has changed everything, as evidence by so many success stories from Moment to Poppy to Ouya and Pebble. These makers found money by connecting with a community of future customers who made it happen for them. And funding accelerators are another great option that not only help you with cash, but also with much needed relation-ships, processes and mentoring.

"In our world, Kickstarter is foreplay. So much other stuff has to happen to create a successful hardware business. And if we're successful, for hardware companies the only barrier to entry will be their passion."

Liam Casey, PCH CEO

Funding Sources

- It starts with you. You have to be willing to take a risk on this if you are going to ask others to do the same. Is selling your car or part of your 401K starting to look real? Good; that means you're obsessed. (For those who answered No, either you are already independently wealthy—congratulations! Or you may have to re-evalu-ate how serious you are about this.)

- Crowdfunding is the name of the game, the place where many startups really get started. It's not about money only, but about validation and social ideation. But it's tricky. Raising $500K on Kickstarter is not longer the anomaly, but shipping 4,000 units on time is no joke. Once again, please, call Dragon Innovation.
    - Crowdfunding: Your first 8 hours a e critical to your success. Months before you kickoff your Kickstarter campaign, start teasing your friends, family, and media with your invention. Start trickling information to build interest, support and viral sharing. And when they day comes, ask 500 people you've nurtured for the past three months to support, you and create that first-day momentum you need to hockey-stick your funding run.

    - Savvy social marketing can be a lifesaver. If that's not strength, consider hiring someone to help you. And if nobody seems to care over social, you might want to pivot your idea before you launch your campaign.

- Accelerators/Incubators are another source of resources. I'm not a big fan of software accelerators, but I'm one for hardware. I wish I knew of one to join when I started in 2010.

- Venture capital is all about money. When the public backs you through crowdfunding, the venture capitalists will start to pay attention. And if someone in this league picks up your project, you may gain access to other resources and partners.

Making it through the Fund gate can feel like the finish line but it's really a mega step. The reason you seek additional funding is to take that prototype and turn it into a finished product for resale. Hardware gets real when you get to **Manufacture**.

Your Funding Gate Resources:

One awesome accelerator you need to join - Highway1

Another awesome accelerator you need to join - China Accelerator

Ping the good people at Bolt to help you fund and staff a team

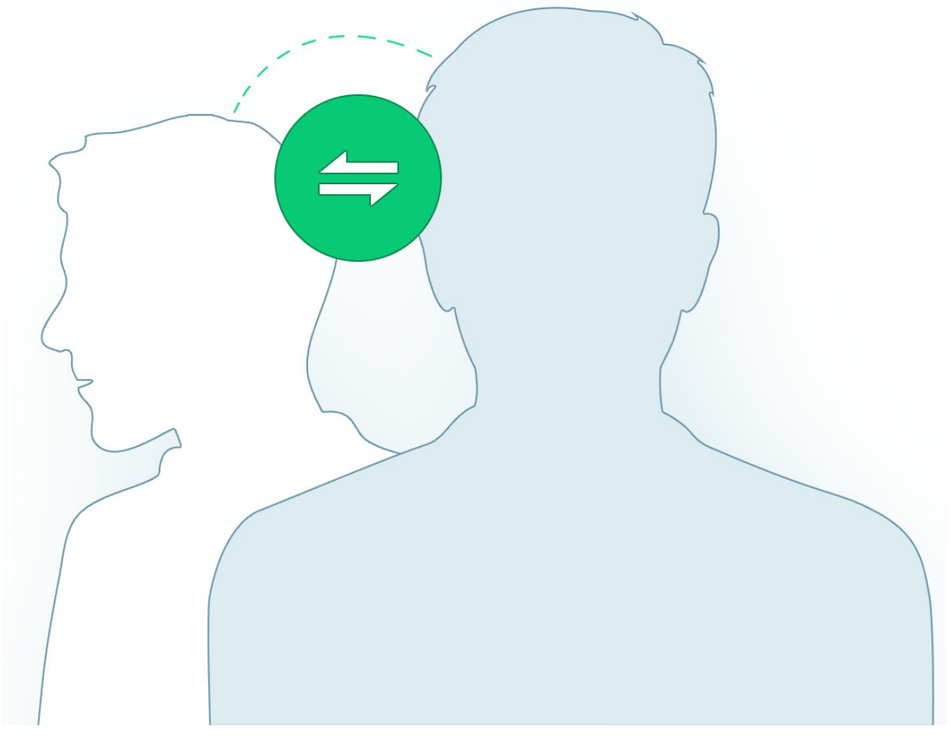
VCs specializing on hardware

Kickstarter's creator handbook - awesome!

Great Slideshare from Cyril Ebersweiler (visionary expert on all things hardware)

HRTrek published a complete guide about this topic you will find super useful

You might also consider offloading your entire project to Quirky!



Gate 4

Manufacture

What's the hardest part of all this? The answer to that will vary from person to person, company to company, and project to project. But without question, the gate with the greatest number of steps, the one with the most unknowns to a newbie, is Manufacture. Now you put your design in the hands of others who have the facilities and knowledge to produce. Getting that done well, it requires skill, experience, and careful communication. A seasoned engineer once told me to consider the path to manufacturing the same as to having a child: Nine months.

After our startup was bought we had to learn very fast about scale manufacturing, USA vs. China, early stage vs. mature. It was hard, and full of friction. You will be creating tools, creating your sub-assemblies, testing tools, doing first runs, and making trips to China or Wisconsin. Distance presents a challenge, and I highly recommend that you start in the USA (or your home country) and only later consider scaling elsewhere. Once again, this is the time to get cozy with companies like Dragon Innovation and PCH as you start to understand tooling, certifications, regulations, logistics, and customs.

Fortunately, some of my friends at Microsoft's XBOX and Amazon's Kindle helped me think through this process, filled with questions and check-offs for you and your manufacturing partners before you kick things off. I'm also grateful for the good folks at Synapse that always help our small Seattle community with a plethora of information about this subject. If you make it through the following list, you are closer (though you never feel totally ready) to passing this gate.

Ready

- Is your complete functional product spec done?
- Are your Bill of Materials and Cost of Goods Sold estimates complete?
- Have you passed all verification tests and gotten approved for production?
- Can you optimize the design to use more common components?
- Have you taken care of tooling, fixtures design and verifications?
- What kind of inventory profiles do you need to maintain?
- Are you 100% sure you have the green light from your Contract Manufacturing partner? Even though this step should have been covered in the final p ototype phase, this is the time to check it again – is the product manufacturable (DFx)? Find out sooner than later.
- China vs. Local. My personal preference is to start locally and scale in China later.
- Be realistic about your volumes so your CM doesn't drop you when you never hit the 5 million units per year target.
- Regularly test and validate your product at the factory. Gary Rayner who founded LifeProof lived in Taiwan and China for a total of 6 months during the early production months of his juggernaut product.
- You don't need to be best friends with your CM leadership. But you need to like them, be able to clearly communicate with them and build trust. Road trip baby.

Set...

- What payment terms have you negotiated with your contract manufacturers or suppliers? Can you increase payment terms to optimize your cash conversion cycle?

- Do any key technologies have cost reductions over time that you can leverage? Did you know that you can usually order components from your CM and cut your distribution free, saving you 20% of your costs?

- How much margin is each of your suppliers or contract manufacturers making? It's important to understand how much of your supplier margin is passed through to your customers, and ensure the value is distributed appropriately.

- What liability will you have if you over-produce and your supply exceeds your demand?

- Do you know when will you start to recover the capital through sales?

- An important note: If you intend to work with Chinese facilities, please learn about Chinese New Year. Factories are closed—like really closed—for over a week, no exceptions.

- Stop here and remember your vision for this product. Quality is everything: Get samples often, test them completely, keep a log of change requests and hold your manufacturing partner accountable to deliver the best quality product. There are no shortcuts here, only painful product returns.

- One last tip I got from a local hardware entrepreneur – visit your CM's warehouse, storage area. Is it clean? Is it dry? Is it climate controlled? Mold, dust, dirt, bugs, these are things that will ruin your packaging and that can kill the dream. Funny how the smallest things that we often overlook can come back to bite us.

Go!

You can write and read entire books on this topic but nobody has time for that. Just make sure you pick the right manufacturing partner that can help you figure things out as a partner, not as a vendor to make your life a lot easier. Okay then, go on to the final gate: Ship.

Your Manufacturing Gate Resources:

China Manufacturing Experts on LinkedIn

A great contract manufacturing partner in Taiwan specializing in metals

Free BOM template

Free COGS template

Join a top accelerators with real experts like Cyril from HAXLR8R or Highway1

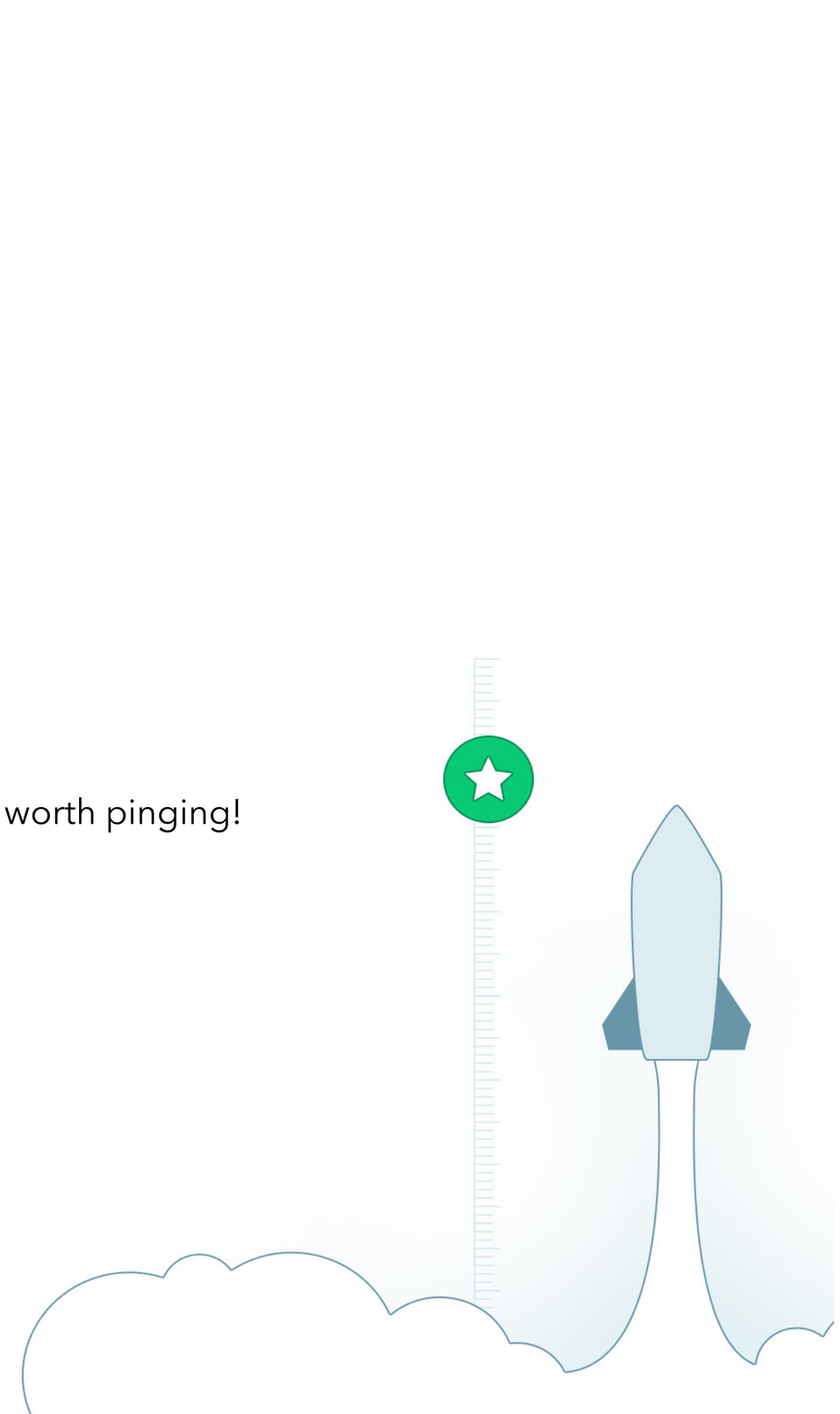
Tap Dragon Innovation for help

Manufacturing partners: Sanmina, Celestica, Jabil, ZaoTech, Wistron

Global Gadget a startup specialzing in navigating the Asia manufacturing maze - worth pinging!

Read:

You need to plan a visit to Huaqiangbei



Gate 5

Ship

"There are two persistent myths for hardware startups. The first is that the end game is selling at big box retailers like Wal-Mart or Best Buy. The second is that once your amaz-ing gizmo is on the shelves it will sell itself. Those two ideas are dangerous."

Cyril Ebersweiler and Benjamin Joffe

If you make it to this last gate, I know you'll be eager to just start selling as soon as possible. This gate is not just about logisitics and shipping, but about your business strategy. You're not done until you have figured out all the details of getting your product into the hands of distributors and consumers. Everything that happens in the areas of distribution, retail, orders and inventory management, shipping, returns, and support happens here.

Consider the following

- Is your business model and go to market plan ready to execute?
- Have you prepared for media outreach for your launch?
- Have you finalized your logistics plan
- Did you look at your factory's warehouse? Where are your products stored after the production line? Where are your products stored back at the home-port? How is inventory being managed?
- What process do you have in place to monitor customer demand and build your product to meet that demand?
- Do you have buffers in place to handle increases in demand?
- Are you ready with your support strategy? How will customers contact you? Who will handle their questions and feedback?
- Is your product repairable? What is the warranty? How will you handle a customer if there is an issue with the hardware? Will you replace with a new product and scrap the old product?
- Have you mapped out your product lifecycle strategy? If your product is successful, it's likely that consumer response will lead to some re-design, and you'll be on to a v2. Start working on your next gen versions before you ship your v1.

Your Shipping Gate Resources:

OrderWithMe - easy, startup-ready supply chain

PCH is the service provider that can help you ship

Use the magic of Amazon's fulfillment service

Support and returns by Amazon

Talk to Genco - the experts

Hot packaging? Convice Tether to give you a sexy deal

Easy e-commernce for hardware startups with Shoplocket

Read:

Logistics considerations and resources

"Demand creation is a result of your positioning (which covers your target user profile pricing and branding) as well as your media, community and marketing activities. If your products are consistently in demand and fly o f the shelves (even if you have limited shelf space), you will find ways to finance growth....Learn how to sell profitably."

Cyril Ebersweiler and Benjamin Joffe

Go for it!

Building hardware products is as rewarding as it is difficult The tactile nature of your product is something that no pure-play software geek will ever feel. The allure of materials, finishes colors, lights, software and utility all coming together – it's magic.

Hopefully reading this has given you some deeper insight into the challenges of a hardware venture. If you like pictures and want to review this from a different angle, check out this awesome deck from a successful maker, Alex Neskin of Petcube, on how to build a hardware startup from scratch. Like me, he wants you to know: Hardware is hard, but people do it every day, and so can you.

Thanks for stopping by!

Adam Benzion