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NAVIGATING THE HURDLES OF HARDWARE START-UPS

PERSPECTIVES FROM SUCCESSFUL HARDWARE ENTREPRENEURS

White Paper

INTRODUCTION

Succeeding with a start-up is a difficult journey. Risk and money are two things that challenge you every step of the way. If you are a hardware start-up, the risks are even greater. Missteps and mistakes can set you back, and the risk is even higher. Money is important, but other things can directly affect the ability to obtain funding. So, is there a surefire recipe for success? Unfortunately not, but if you are considering starting a hardware company or are in the early stages of your company lifecycle, there are several key areas, that, if approached with prior knowledge, can increase your chances of success. Some key areas:

- Securing funding through different sources
- Working with incubators and accelerators brings tangible benefits
- Protecting intellectual property (IP)
- Field-testing brings you closer to the customer
- What type of prototypes work best?

This white paper examines each of these areas in more detail. It offers helpful guidance to early-stage hardware entrepreneurs that can lead them down the path to success. The white paper also offers nuggets of wisdom from successful entrepreneurs who have gone through some growing pains and are continuing to lead their companies as successful, young enterprises.

SECURING FUNDING THROUGH DIFFERENT SOURCES

Some of the biggest challenges facing any hardware start-up involve locating sources of capital and managing cash flow. Many start-ups are initially run through bootstrapping (self-funding), which can get you through the short term, but may leave you with mountains of debt. In some cases, hardware start-ups are formed out of extensions of collegiate projects or research. In these cases, universities can often provide some initial research seed funding to carry the project for a little while. However, good entrepreneurs plan their funding route long before they run out of money. Fortunately many opportunities to access funding are available today, but it's good for entrepreneurs to understand what the best options are given their set of circumstances (e.g. stage of lifecycle, type of product, how much control they want to cede in exchange for capital).

Funding can come from many sources and will depend on the stage of your company. Many high-tech hardware start-ups look to local colleges and universities for innovation challenges and competitions through which they can be awarded up to US$100,000 or more in prize earnings. For example, Massachusetts Institute of Technology has the $100K Entrepreneurship Competition., Stanford University has the BASES Challenge, and the University of Waterloo has Velocity. In addition, some large tech accelerators, such as Cleantech Open and IC tomorrow's Wearable Technology Contest (UK), run contests with winners at the local level advancing to regional levels and beyond to compete on the national stage. In these cases, the award money may be larger due to the scope of the contest and the capital available. In many instances, winners of these contests also secure mentorship in addition to the cash awards. Mentors are made available in a variety of areas including investment, legal, go-to-market strategy, manufacturing, and scalability. Mentors are usually previously successful entrepreneurs who have been through the process of moving a start-up forward. Their wisdom and expertise in solving critical business issues can dramatically increase the chances of a start-up's success.

Many high-tech hardware companies take advantage of government grants. Many states offer grants to fledgling start-ups in an effort to not only help them grow, but to keep their employment in-state. The states see the start-ups as workforce development engines. Be aware that applying for government grants is time-consuming and can take up a lot of resources, the most important of which is your time and that of your development team. "Applying for grants was all report-writing and filling out applications," stated Chris Goodine, developer evangelist of Thalmic Labs, makers of gesture control armbands, in Kitchener, Ontario. However, the reward can be worth the work.

"We probably got about C$200,000 through government grants," continued Goodine. "They were targeted at helping early-stage tech ventures in Ontario and trying to keep innovation in Ontario."

Crowdfunding is another source of funding that has become popular over the last few years. Online crowdfunding companies like Kickstarter and Indiegogo offer platforms for companies seeking capital to raise money through community awareness and donations. In essence, a company can get hundreds or thousands of smaller donations amounting to millions of dollars, which can be easier to secure than one or two angel investors. At the same time, crowdfunding allows the start-up's founders to maintain a greater share of the company's equity and control. Many companies choose this route early on when they need to prove market demand to angel investors or venture capitalists (VCs).

One example of a company that has validated this approach to obtaining funding is SKULLY, a start-up in the wearable technology space. The company produces a "smart" motorcycle helmet that provides riders both safety and a heads-up display with lots of environmental information without distracting the driver. SKULLY started its crowdfunding campaign on Indiegogo.com in August 2014, and raised US$2.4 million in two months. What they did was offer presales of the product—essentially taking in revenue as opposed to strict capital investment. In addition to the benefit of raising needed capital, the Indiegogo campaign justified the market demand very quickly, which enabled SKULLY to more easily secure VC funding in its next phase of investment. Had they not done crowdfunding first, proving the market demand would have been a supreme challenge.

Another interesting aspect of raising funds in the hardware space is how it is often tied to having a demonstrable prototype. In many cases, especially in high tech, specifically wearables, investors want to see how things look, feel, and work before they invest. Entrepreneurs in this space will benefit from building a working prototype as early as possible; otherwise, they risk being unable to secure funding at required times. These prototypes are often created as a result of feedback from crowdfunding donors. Chris Goodine, Thalmic Labs, advocates creating prototypes early for market validation:

> ***"You have to iterate quickly. This goes for all entrepreneurs, whether you are in the software space or the hardware space, the first thing that you come up with, the first product or the first piece of code, or whatever, that you come up with, is always going to be crap. You have to test it, you have to prototype it, you have to test it, you have to validate it, you have to get people to use it, and you have to iterate. That cycle has to be as quick as possible to get your product to a point where you can release it and get more feedback on a wider scale, and then eventually create something that's awesome, that people will want."***

Creating prototypes early can greatly assist in fundraising efforts.

The demand created by crowdfunding donors validates that the product meets their needs—which sends a strong positive signal to potential investors once they see prototypes that incorporate the customers' feedback.

One of the most interesting challenges of funding start-ups is when you seek money from outside that involves funding in exchange for equity in the company or some level of board control. Entrepreneurs must think carefully about the trade-off involved between securing needed funding and giving up something in return. If you are a visionary technology company with a progressive roadmap, you should make sure the VC is aligned with your vision of how the technology or product focus evolves with time. In some instances, the VC may require singular focus on a particular application area, while others may encourage you to branch into different areas or markets as the technology evolves. For example, Robot Rebuilt, an emerging robotic technology venture in Massachusetts, is very careful about working with potential investors who are aligned in the product vision. Eduardo Torres-Jara, president of Robot Rebuilt and assistant professor at Worcester Polytechnic Institute (WPI), says, "The financial cut is not usually the problem, but usually the control, given that we have a large vision and we want to do one product, which takes us to another product and so on, until we get to the last product. We are particularly careful about what money we get, so we look for VCs who are visionary and who are really aligned with what we want to do."

WORKING WITH INCUBATORS AND ACCELERATORS BRINGS TANGIBLE BENEFITS

While funding plays a major role in the success and evolution of a high-tech start-up, another factor that can strongly influence the path a company takes is participation in incubator and technology accelerator programs. Start-up incubators and accelerators assist entrepreneurs in the journey toward becoming successful companies, but each in their own way. One of the most distinct differences between accelerators and incubators is the time frame of each. An accelerator works with start-ups for a short and specific amount of time, usually from three to four months. Accelerators also offer start-ups a specific amount of seed capital, usually somewhere around US$20,000. In exchange for capital and guidance, accelerators usually require anywhere from 3 to 8 percent ownership of the company. Accelerators help start-ups discover in the shortest amount of time possible if they have a business opportunity, which in the hardware space means developing a workable prototype as quickly as possible. Ryan Vineyard, engineering lead for Highway1—a hardware accelerator out of San Francisco, California—really sees an advantage for start-ups to get their prototypes out in the market early. "Our design lead really pushes people to get out in the real world, get their prototypes in people's hands, do small beta runs where you have 10, 20, 50 units out there to really get that feedback, find out what do users actually want before you go out for the big launch, before you go out for crowdfunding and tell the world, 'Hey, this is what I'm making.'"

Using an incubator or accelerator can speed a start-up's path to commercialization.

Incubators, on the other hand, focus more on growth over time and offer mentoring that often lasts more than a year and a half. The goal of some incubators may be to prepare your company for an accelerator program. Incubators take little to no equity in your company, and can afford to because they do not provide up-front capital like accelerators. Many incubators are funded by grants through universities, allowing them to provide their services without taking a cut of your company.

Accelerators can range from highly selective internationally known entities like Y Combinator, to a community-based open collaborative program like Radicand Lab. Y Combinator is a hardware accelerator based in San Francisco, whose main focus is to help young companies position themselves to raise more capital. They select a number of technology start-ups each year and have become an elite accelerator within the high-tech community. Radicand Lab considers itself a design collaboratory. They help hardware companies quickly produce prototypes through design services, as well as provide technical expertise through a community-based model. There are also a number of incubators and accelerators with models in between, such as Highway1, which operates as an accelerator for early-stage hardware start-ups. Highway1 is a division of PCH, a large multi-national contract manufacturer. Highway1 not only offers accelerator services, but can provide small companies access to the manufacturing resources of its parent company, which can offer real benefit as the start-up needs to scale manufacturing of its products.

Hardware technology start-ups also face a unique challenge of needing access to manufacturing resources. In most cases, these resources are expensive. Hardware accelerators often provide access to manufacturing resources to entrepreneurs who are selected for their programs. These resources can range from simply using a 3D printer for prototypes, to accessing full-scale manufacturing facilities overseas. Entrepreneurs learn how to scale up production and what that means for their business. Many entrepreneurs are either engineers or business people with little or no background in manufacturing, so this option provides an invaluable resource to them as their company evolves. HAX, a hardware accelerator based in San Francisco, California, offers successful applicants the opportunity to spend over three months in China, learning about manufacturing, prototyping, and supply chain management.

Entrepreneurs are faced with a myriad of choices when it comes to leveraging an incubator or accelerator. However, one thing seems clear. Those companies who have taken advantage of them will testify that they would not have succeeded without them. Lisa Fetterman, CEO and founder of Nomiku, a successful start-up in the food industry, offers this perspective:

"The biggest benefit that I got out of each of them (accelerators and incubators) is a network of entrepreneurs. Being an entrepreneur is an extremely lonely ordeal. You hit walls all the time. It's such an emotional ride that if you don't have a support system and a community it's very, very easy to just want to give up."

— Lisa Fetterman, CEO and Founder of Nomiku

Benefits of Working With Incubators and Accelerators

Whether you work with an accelerator or an incubator, each has pros and cons. For starters, the advice and guidance of mentors can help you avoid mistakes that could cripple your start-up if you were trying to go your own way. Greg Kress, founder and CEO, Radicand Lab, feels accelerators can answer some key issues hardware entrepreneurs have. "We help start-ups answer the following questions: What do consumers actually really want? What do investors really want to see?, and what is the right way to devote your resources in the very earliest, most critical stages of your company?" Both options also provide access to capital that may have been otherwise unavailable, whether it's during or after mentorship. Additionally, both accelerators and incubators provide the space to develop your idea. Lastly, being a part of an accelerator or incubator can provide invaluable connections, and some may also have networking events to help you boost your exposure.

One of the biggest benefits of working with an incubator or accelerator is the sense of community and camaraderie. Starting a company can be a lonely, isolating experience. When you are in an incubator or accelerator, you are often surrounded by other entrepreneurs who are at different stages of their company's lifecycles. Chris Goodine reflects on his experience with Velocity Accelerator—a hardware accelerator program from the University of Waterloo:

> ***"You have got all those people at all those different stages, and everybody talks with each other, everybody helps each other out. It's an amazing environment to be in because no matter what problem pops up in your own company, there is somebody else you can go and talk to, to figure out how they worked their way through that problem or advice that they have on it."***

Mitchell Weller, vice president, Business Operations and co-founder, SKULLY, agrees:

> ***"Being around those people, it puts everything in perspective. It really helps them to mitigate that failure barrier aspect. Everyone feels like they're failing all the time, but then when you get everybody together and they talk about all the things they're struggling with and then all the things that they do really well, it builds the community around that. It helps people to keep going."***

Incubators and accelerators also provide invaluable access to key resources within the technology community. These resources can range from specific technology mentors to legal resources. Early-stage technology companies don't often have the in-house resources to navigate all the legal hurdles, such as IP protection, patents, and contracts. Mentors and business advisors can help entrepreneurs stay focused on the commercialization of the technology. Often as engineers, entrepreneurs are very engaged in developing breakthrough technology, without thinking of its commercial viability. Keeping focused on setting development goals and keeping them rational for business reasons is very helpful through the mentoring process.

However, while there are many benefits to working within an incubator or accelerator, there are possible disadvantages too. Sometimes these programs want an equity stake or some level of control that may not align with the entrepreneur's vision. In addition, if you are in a very specialized field, such as robotics, you may need to be very selective to find a program with the right expertise. Many entrepreneurs are not willing to compromise on their vision or need very specialized help, so it is important to select the program that is the right one for you.

Accelerators helped hardware start-up Nomiku better understand the manufacturing process.

PROTECTING INTELLECTUAL PROPERTY (IP)

In the hardware world, patents create a sustainable advantage for technology companies. Protecting your original designs and technology not only builds a competitive barrier to entry, but can also put small companies in a position of strength when it comes time to partner with a larger firm or potentially exit through acquisition. The stronger the patent portfolio, the more valuable the small company becomes.

Intellectual property can come in many forms. At its simplest form, entrepreneurs think about IP as design and technology developments. However, the circle can be expanded to include employees, partners, suppliers, and contractors. All these human capital elements contribute to the creation of IP. In addition, executive contracts and ideas that are brought in should be well crafted to protect anything that may come to be a problem later. Creating and using proper documentation can make a huge difference down the road.

Many technology companies are also unaware that in the legal world, there is a concept called enabling public disclosure (EPD), which means you have publicly shared enough about your product to allow someone with the same level of knowledge as another in the industry to copy your product. Common examples are exhibiting the product and how it works at a trade show or within an article in a publication. One year following an EPD, you cannot patent that product or invention. Therefore, it is important to keep your technology out of the public eye until you are confident it is legally protected.

Entrepreneurs have a lot to think about in their daily business lives. Attitudes toward protecting IP can range across the board. In some instances, creating and protecting IP is culturally embedded from day one. Mitchell Weller, of SKULLY, explains, "We're filing IP all the time. We actually have cash incentives for employees to file IP. We actually encourage everybody to be active in the IP process, just because it's such a core part of building a business, building a brand." Other companies approach the protection of IP as a necessity, but don't worry as much about it day to day. According to Lisa Fetterman, "I get it [IP] done because I need to. It's like mopping the floor; I get it done because I need to." She is not worried about someone copying her. "If somebody copies me I'm like, halleluiah! I'm winning."

Many entrepreneurs who develop products with a combination of hardware and software often take the middle road. They protect the hardware technology with patents, but consider

Protecting intellectual property is a key consideration for early-stage hardware companies.

embedded software "trade secrets." Once you file a patent on something, you are disclosing your methods and technologies. Here is a perspective from Chris Goodine, Thalmic Labs:

> *"It makes sense in some cases, like with some of the algorithms and stuff that run on the Myo. We don't necessarily patent those because nobody has access to that, so there is no point in disclosing in a patent, how you do things. It could be valuable to not necessarily file a patent on some things."*

FIELD-TESTING BRINGS YOU CLOSER TO THE CUSTOMER

Hardware start-ups have an interesting challenge. Unlike software companies, they need access to manufacturing facilities to create physical prototypes as well as enough early production units to enable proper field-testing. Today, the success or failure of a company that is betting its future on one product is dependent upon its ability to capture the attention of the market, which means delivering test units for prospective customers to evaluate and provide feedback. Creating early "minimally viable" production units that can be field-tested as early as possible enables easier design changes and a better product in the long run. Field-testing can be done through presales or a limited run of preproduction demo units. The key thing is to "build, measure, and learn." In other words, build some test units, have them evaluated, and test assumptions. If changes are needed, re-engineer. Then, repeat the cycle, and do it fast.

Capturing and incorporating market feedback through field-testing can increase your chances for success.

SKULLY, for example, started field-testing very early in its development process. Mitch Weller explains:

> *"We started riding them (the helmets) back before demo, when we launched in the fall of 2013. It's just been constant testing of every single feature, every single physical component, to the point where we are confident that not only will it pass all of the certification testing, but it passes our internal testing. Would we want to own it? Would we want to use it?"*

In the case of wearable technology, it comes as no surprise that people come in all shapes and sizes. So field-testing is very important to make sure products not only fit well, but function uniformly. In the case of Thalmic Labs, they needed to ensure the product's sensors picked up the correct movements of the user's hand, regardless of size or gender. Chris Goodine explains:

Rigorous testing of prototypes helps ensure a high-quality product is released to the market.

"We really needed to be sure that the mechanical design would properly fit girls who have smaller forearms and are typically less hairy, to guys who, a lot of the time, have larger forearms and more hair. The different kinds of bumps and valleys, and peaks around the circumference of the forearm; we needed to make sure that they weren't hanging the sensors up, so that they would perch on top of them and not touch the skin. We needed to make sure that the Myo would work across all of these different variables on a large number of people. The only way we could do that was to do a ton of field-testing to ensure proper fit on people."

As an early-stage organization goes through the field-testing process, there are often lots of design changes. Given most early-stage start-ups are very lean cashwise, they need a way to make design changes and create iterative builds of the product more efficiently. Many companies use 3D design software, like SOLIDWORKS®, to help them quickly make design changes and facilitate quick turnaround to manufacturing for more test units. They can also quickly build 3D electronic prototypes, which can enable quicker approvals for design changes, as well as get full-product illustrations into the hands of those who may be interested in the product, which helps to sell it.

WHAT TYPE OF PROTOTYPES WORK BEST?

In addition to field-testing, the ability to quickly and efficiently design and build a prototype can be a key success factor for many hardware technology start-ups. In many cases, additional capital, whether it comes in the form of prize money, angel investment, or VC money, hinges on the company's ability to have a working prototype as early in the process as possible. This is particularly true with high-tech products, such as wearables and robotics.

Creating physical prototypes can be expensive. Start-up companies that are trying to conserve cash may need to create multiple versions of the product as they progress through their early stages. Wearables, for example, which incorporate both hardware and software components, require more physical prototypes than other products. Some wearables, such as SKULLY's

intelligent motorcycle helmets, are considered safety equipment, which must be certified to meet government safety standards. However, in many instances, while physical prototypes may be required under certain circumstances, many hardware companies can more effectively use visual 3D prototypes to perform part and system stress-testing through simulation. This enables cost-effective testing prior to parts going to the factory for production, avoiding the problem of finding out later they may not work correctly under load. These mistakes can be costly for any company, but are more magnified for start-ups that do not have extra capital to waste. Many hardware start-ups use computer-based analysis tools, such as SOLIDWORKS Simulation solutions, to help them cost-effectively test and validate their designs.

"We can cut down on the cost of 3D printing because we can test the parts before we even take them off the computer. So, we know what failures to expect and what failures to test for. That really rapidly cuts down our testing cycle and increases the quality because you get to put things through the rigors before you waste the time to build it. That's been infinitely valuable."

— Mitch Weller, Co-founder of SKULLY

CONCLUSION

Starting a hardware company is a daunting task. Entrepreneurs face a lot of hurdles. They need to identify and secure the most appropriate funding; decide on the IP they want to protect and make it happen; determine if working with an incubator or accelerator makes sense and which to apply to; seek guidance from seasoned mentors who can guide the growth and development of their fledgling organization; enter a community of like-minded and passionate individuals; and design physical and/or simulated prototypes and build them fast to get real feedback from real, potential customers. It can be a lonely journey, fraught with many uncertain times. Understanding how other entrepreneurs have successfully navigated these hurdles can improve your odds of success. As we all know, there is no one road to success, but to think through the options available and learn through the lessons of others may make the journey a smoother one.

▶ For more information on the SOLIDWORKS for Entrepreneurs program, visit www.solidworks.com/entrepreneur.

ADDITIONAL RESOURCES

Here is an additional (but not exhaustive) list of resources which hardware entrepreneurs might find useful in their research.

Websites

Making Society – http://makingsociety.com/

The Lean Start-Up – http://theleanstart-up.com/

"Why The Lean Start-Up Changes Everything," Harvard Business Review online
https://hbr.org/2013/05/why-the-lean-start-up-changes-everything

Books

"Disciplined Entrepreneurship"
http://disciplinedentrepreneurship.com/
"Zero to One"
http://zerotoonebook.com/

"The Start-up Owner's Manual"
http://www.amazon.com/Start-up-Owners-Manual-Step-Step-ebook/dp/B009UMTMKS

"The Hardware Start-up: Building Your Product, Business, and Brand"
http://shop.oreilly.com/product/0636920030805.do

"Crossing the Chasm"
http://www.amazon.com/Crossing-Chasm-Marketing-High-Tech-Mainstream/dp/0060517123

"Best Entrepreneur Books to Build a Hardware Company"
http://makingsociety.com/2014/10/best-entrepreneur-books-hardware/

Entrepreneurship Blogs

Business Pundit – http://www.businesspundit.com/

TechCrunch – http://techcrunch.com/

VentureFizz – http://venturefizz.com/

Venture Capital Dispatch – Wall Street Journal - http://blogs.wsj.com/venturecapital/

Young Entrepreneurs – http://www.entrepreneur.com/topic/young-entrepreneurs

OnStart-ups – http://onstart-ups.com/

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