Bel Air Camp's *Accompagnement* Program: Evaluating and Addressing the Challenges of Lyon's Hardware Startups

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Abstract

This project evaluated the needs of hardware startups in the Rhône-Alpes region and assessed Bel Air Camp's Accompagnement Program. Our interviews and surveys of hardware startups determined that each startup is unique, and funding is their greatest challenge. We recommend that the Accompagnement Program provide fundraising services in addition to product and business development services *à la carte*. Ultimately, these recommendations provided Bel Air Camp with a suggested framework of services that will increase the effectiveness of the Accompagnement Program - assisting Bel Air Camp in becoming the hub of hardware in the Rhône-Alpes region.

Executive Summary

While France traditionally has been known to resist globalization, it has recently shifted away from this stereotype and seeks to become a global leader in technology. The nation promotes a growing ecosystem of startups that manufacture hardware or physical products. Hardware production employs 2.8 million people and accounts for 10% of France's GDP. **Startups in the hardware industry strengthen this economic sector** by bringing new technology to market and positioning France as a global leader in hardware. Despite an increase in support for hardware startups, the arduous process of product development poses unique challenges. Hardware startups must create physical prototypes in order to develop and refine their products, which requires significant time and funding.

A variety of resources have been developed within France to promote the success of hardware startups. This **ecosystem is comprised of a network of resource centers**, such as incubators, accelerators, and product development programs. Incubators and accelerators assist hardware startups with business development and the acquisition of funding, whereas product development programs provide the knowledge and technology necessary to design and build prototypes. The product development process is the method by which hardware startups turn ideas into prototypes and ultimately into physical products that will be manufactured and sold.

The **Accompagnement Program** – the focus of our project – is a product development program run by Bel Air Camp, our project partner. Bel Air Camp is a startup community center in Lyon which offers office space and networking for startups. The Accompagnement Program focuses on the product development process and provides additional business development services through a partnership with 1KUBATOR, a local startup incubator. As of June 2019, Bel Air Camp is entering into a new partnership with Kickmaker, an industrialization consultant. This partnership will place the Accompagnement Program under the management of Kickmaker, and will also begin a new initiative, the Kickmaker Assembly Line (KAL), which will focus on producing limited runs of prototypes for manufacturing. The importance of our study was amplified when it became a priority to position the KAL program strategically within the Lyon ecosystem. Under its new management, the Accompagnement Program must address the challenges faced by hardware startups in the Rhône-Alpes ecosystem. The program's future success depends on aligning its resources with the needs of startups in the context of this current ecosystem.

To **align the Accompagnement Program with the needs of hardware startups,** we completed three research objectives. The accomplishment of these objectives resulted in a holistic yet specific understanding of what kind of program would be most successful in helping hardware startups. First, we **evaluated the current hardware startup ecosystem** in the Rhône-Alpes region. We conducted interviews with eleven hardware startups and four resource centers, then used these findings to develop a survey for a larger group of hardware startups. The survey results and subsequent analysis provided information about the challenges, needs, and preferences of hardware startups, as well as their interest in resource centers. Second, we **assessed the Accompagnement Program**'s current operation and structure. Finally, we **compared the needs and preferences of hardware startups with the current offerings** of the Accompagnement Program to craft recommendations for Bel Air Camp.

Our research **identified several important and original findings** regarding the needs of hardware startups. Most importantly, **every hardware startup is unique**, with different experiences, knowledge, and connections. Therefore, each startup has different challenges and resource centers should offer programs that are tailored to this diversity of needs. The **biggest**

challenge that hardware startups face is funding rather than technical obstacles such as a lack of knowledge about prototyping or engineering. Many resource centers lose potential customers because they place too much focus on providing equipment and technical support, while the lack of funding and fundraising support causes hardware startups to struggle through technical challenges on their own rather than spending money to use a resource. Finally, **startups join resource centers to enhance their reputation** and obtain professional connections and networks.

Based on these findings, **we developed several recommendations** for the Accompagnement Program. The program should put a greater focus on **helping the hardware startups to acquire funding** while offering specialized services for product and business development with ***à la carte* pricing**. Integrating fundraising into the program, either as an internal service or through a connection with a larger fundraising initiative at Bel Air Camp, will make the Accompagnement program more attractive and accessible for hardware startups. By pricing the program services individually, each startup will customize the program to meet their unique challenges without paying for services they do not need. In addition, we recommend the Accompagnement Program **specialize its services** for hardware startups and adapt its price and scope to meet the unique needs of each startup.

Results of Interviews and Surveys

The survey was emailed directly to 145 hardware startups, including nine startups from Bel Air Camp. We additionally distributed it via our Bel Air's LinkedIn newsfeed. We received a **total of 58 responses**, 41 of which were fully complete, and seven of which were from startups within Bel Air. Combining the interview data with the survey results revealed the challenges that hardware startups experience, the resources they have available, and the strategies they employ to decide whether these resources are worth their time and money. Our analysis of this data extracted five key findings:

1. Each startup is unique and has different needs.
2. Hardware startups' level of experience affect what type of services they need.
3. Hardware startups will use multiple resource centers to best meet their needs.
4. Hardware startups do not want a *prix fixe* program.
5. Hardware startups highly value their reputation and image.

A key result that supported the first finding was the variation among the experience and education of each startup's founders. Each founder we interviewed had **different levels of experience and knowledge**. In the survey, we tested this qualitative data by asking hardware startups whether their founders had experience or education in six different areas: engineering, management, marketing, entrepreneurship, finance, and startups. Responses varied across the entire range with no significant patterns. Many of the hardware startups we interviewed only used resources that offered services in areas where they had limited experience. They consistently used resources that provided knowledge and skills they were lacking, while they did not use resources that provided services for things they already knew how to do. Therefore, each hardware startup will have unique needs and will only use resource centers that fulfill a gap in their knowledge or experience.

The second finding was that **hardware startups with less experience were more likely to be interested in resources** than startups with greater experience. Through the survey, we discovered that on average, startups with less than three areas of experience were 35% more interested in resources and programs than startups with four or more areas of experience. This finding is supported by interview data showing a discrepancy between the resource usage of

experienced and inexperienced startups. For instance, an experienced startup said that they needed advanced technology such as high-end 3D printers, a specific and high-quality resource. Meanwhile, a younger and less-experienced entrepreneur stated that he used an incubator with access to a workshop, since he felt he did not have the depth of knowledge to develop a prototype and business model without the incubator's variety of resources. Experienced and knowledgeable startups want specific, high-quality services. Less-experienced startups were interested in broader, more cost-effective services due to a greater gap in knowledge.

The **use of multiple resources to meet the specific needs** of hardware startups was a trend in our interviews. Many of these resource centers and programs specialized in one specific service, such as funding or prototyping. For instance, one interviewee contracted a team of engineers to design their prototype, used an accelerator to develop the prototype, received funding from a separate network of investors, and subcontracted production of the product through unconnected manufacturers. The survey confirmed this finding, as 59% of our respondents used more than one resource center or program. Hardware startups want the resources most suited to their needs, and they are willing to use multiple programs if that is the best way to fulfill their requirements.

We also asked hardware startups if they were interested in a program that offered a wide range of services: only 34% expressed interest, even though a larger percentage expressed interest in each individual service. Those respondents who were uninterested in a program with many services assumed that they had to pay for everything. Furthermore, 57% of our respondents chose not to use a resource center because it did not align with their needs. These two statistics, coupled with the previous two key findings, suggest that **hardware startups do not want an all-inclusive, *prix fixe* program**. Rather, they might prefer a program in which they only have to pay for services in the areas where they have a lack of knowledge or experience.

Our data also examined why hardware startups chose to join resource centers. When asked why a startup used a resource or program, the most common response (37%) was that the service offered connections that the startup could not obtain on their own. The second most common response (23%) was that the service could help improve the reputation of the startup. In interviews, many startups expressed the importance of connections to potential customers, investors, and manufacturers. Furthermore, interviewees and survey respondents truly cared about the image and reputation of their hardware startup. Therefore, they **value the connections and reputation** that resource centers can offer.

Assessment of Accompagnement Program

We assessed the Accompagnement Program through interviews with its manager and current participants. During the interviews, we evaluated the current perceptions, structure, and resources of the program. Finally, we compared the needs of hardware startups within the Rhône-Alpes ecosystem to the resources offered by the Accompagnement Program to make recommendations for how to better align the program to meet the challenges hardware startups face.

The Accompagnement Program is comprised of four bricks: **Space, Network, Expertise, and Methodology**. These bricks are the four primary aspects of the program. For space, the participants in the program have access to the Tech Park – a workshop with prototyping tools within Bel Air Camp. For networking and expertise, the program has partnered with 1KUBATOR, a business and software development incubator. The partnership has created a joint venture called 1KFABRIK, in which product development occurs at Bel Air Camp and the business and software development occurs at 1KUBATOR. As part of this program,

1KUBATOR provides hardware startups € 25,000 in exchange for 10% equity. € 12,500 goes towards 1KUBATOR's services, and the other € 12,500 goes to the startups as cash, which can be used to pay for the Accompagnement Program at Bel Air Camp. The Accompagnement Program also has connections with engineering consultants to provide access to any technical engineering knowledge needed by the hardware startups. Furthermore, beginning in 2019, the program will be partnering with Kickmaker to provide industrialization services after the product development is completed. Finally, the program's methodology outlines the three stages of product development and assists hardware startups through this process with the integration of agile and lean development techniques. The three stages are Proof of Concept (POC) (2 months, € 1,200), prototyping (4-5 months, € 2,500), and mini série (5-6 months, € 4,500).

Comparison

Through a comparison of the needs of hardware startups and the resources of the Accompagnement Program, we have identified **aspects of the Accompagnement Program that are working well** and should be kept as the program merges with Kickmaker.

First, the program had solid mechanical prototyping equipment at the Tech Park and mechanical knowledge provided by the manager of the program. The program participants commented on this expertise.

Second, the individual product development stages of the program methodology, as well as optional use of 1KUBATOR and engineering consultants, make the program relatively flexible to meet unique needs. Similarly, startups do not need to pay for each stage of the product development process, only the stage(s) that they are interested in. The program also has connections within the Lyon startup ecosystem through its partnerships, which we found to be quite useful and attractive to hardware startups. For instance, one of the program participants joined solely because of the connections that the program offered. Lastly, we found that the business development support was helpful and attractive to hardware startups with that need.

Alongside these strengths, there were several **areas for improvement**. For instance, the program needs better non-mechanical prototyping knowledge and machines. Multiple program participants had to spend excess funds to contract out specialists in fields such as electrical engineering.

In addition, the funding, marketing, networking, and software development services offered by the 1KUBATOR partnership were not optimized for the specific needs of hardware startups. From interviews and testimonials with program participants, these were not geared towards hardware, nor were they adapted to each hardware startup's unique needs. Furthermore, 1KUBATOR's software and business development services all have one set cost of 10% equity in the startup. This does not allow startups to choose and pay for only the specific aspects that they need.

Finally, more connections with manufacturers would be beneficial to industrialize the product after the mini série stage, although this will most likely be fulfilled by the future partnership with Kickmaker. In the following section, we will outline specific recommendations which address the needs of hardware startups and the areas in which the program is lacking.

Recommendations

In order to align the program with the needs of hardware startups, we offered Bel Air Camp **recommendations in five areas**:

1. Assist startups with funding.
2. Offer services *à la carte*.

3. Target specific audiences based on experience: quantity vs. quality
4. Enhance online presence to target younger startups
5. Make more connections to the hardware ecosystem.

Assist startups with funding: The greatest challenge for startups is funding (38%), rather than prototyping tools (8%) or technical knowledge (20%)– the main offerings of the Accompagnement Program. We highly recommend that the program prominently integrate a service to help hardware startups acquire funding. Bel Air Camp has expressed an interest in creating such a program, which could be used both for its own hardware startups and for the participants of the Accompagnement Program. This service will make the program more attractive to startups, both by providing a needed service and by making it easier for them to pay for other aspects of the program.

Offer services *à la carte*: Since hardware startups are all unique and have different needs, they are not interested in paying for the entirety of a *prix fixe* style program. We recommend that the Accompagnement Program continues to offer numerous services in business, product, and software development, but to price them *à la carte* under one name. This will give hardware startups access to many services in the same place, and to select and pay individually for the services that they need most.

Target specific audiences by experience: Because hardware startups have different needs based on their level of experience and choose to use the resources which are best suited for their individual challenges, we suggest that the program specialize for a particular demographic. Due to the distinction between the quality and quantity of services demanded by more- and less-experienced startups, we suggest that the program target one or the other to best attract and assist that audience, rather than generalize for everyone.

Enhance online presence: Our survey found that 30% of startups founded less than a year ago, and 22% of all hardware startups, used internet research to identify resources. Most of the respondents to our survey, particularly older and well-established startups, found resource centers via networking or word of mouth, but the Accompagnement Program already utilizes this channel of communication. Conversely, the Accompagnement Program and 1KFABRIK have limited internet marketing and could be missing out on a large segment of clients. Strengthening their internet marketing could be a new opportunity to reach a new sector of the market and attract early-stage hardware startups.

Provide connections in the ecosystem: Increasing the program's presence and connectivity in the hardware startup ecosystem is another way to attract new customers and strengthen the program. 59% of hardware startups chose to use resources to obtain connections they could not make on their own or to improve their startup's reputation. By being present at conferences and events and continuing to make mutually beneficial partnerships with key actors in the ecosystem, the program will be more successful. Hardware startups within the program will have better access to connections with outside investors or potential clients through an increase in reputation.

These recommendations will align the Accompagnement Program within the hardware startup ecosystem in Lyon to meet the unique needs and challenges of hardware startups. By focusing on funding, the program will attract hardware startups. Offering its services *à la carte* and under one name will allow hardware startups to customize a program to be most useful to them. Catering these services either to more- or less-experienced startups will optimize the program for one audience, increasing its effectiveness. Lastly, the more connected the program is within the ecosystem, the more successful the future program and its participants will be.

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Glossary of Abbreviations, Acronyms, or Terms

Abbreviation/Acronym/Term	*Definition*
À La Carte	Customers pay for each part of the program individually
BPI	Banque Publique d'Investissement
Hardware Startup	A startup whose product is physical and tangible
KAL	Kickmaker Assembly Line
Mini série	A limited run of manufacturing which allows hardware startups to test larger-scale production and make money
POC	Proof of Concept
Prix Fixe	Customers pay a fixed cost for the whole program, regardless of which parts they use
Product Development	The development of a product from design to manufacturing, including a POC and multiple prototypes.
Prototype	A crude yet functional version of a product, used to test and refine its design
Startup	A small company characterized by extreme uncertainty and fast growth
SWOT Analysis	Strength, Weakness, Opportunity, and Threat Analysis
Technology Startup	A startup whose product involves technology

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1.0 Introduction

In 2018, the French government rolled out the 'Big Investment Plan,' allocating 13.1 billion euros of public funds over the next 5 years to "secure global competitiveness through innovation," (The Big Investment Plan, n.d.). While France has historically been regarded as a country resistant to globalization (Barlow, Nadeau, 2003), the Big Investment Plan proves that France is taking new steps to become a global leader in technology. Part of this initiative has been the promotion of a growing ecosystem of startups in technological industries (The Big Investment Plan, n.d.). This rise of technology startups (early stage companies that bring a new technology to market) strengthens the national economy by creating new jobs, prompting local and foreign investment, and bringing new French technology to market ("What is a Startup Ecosystem", 2019). Furthermore, technology startups are essential for France to remain competitive with countries like the United States and Israel, both innovation powerhouses with flourishing ecosystems such as Silicon Valley and Tel Aviv (Moskvitch, 2011).

To remain globally competitive, France developed La French Fab, a government program targeted specifically at hardware production (What Is The French Fab?, n.d.). Hardware production has been slowly on the rise in the recent past, growing globally 1% from 2015 to 2017 (Moore, 6, 2017). According to the S&P Global Ratings, this growth is expected to continue in the coming years (Moore, 2017). In France, hardware production is crucial to its economy, employing 2.8 million people and accounting for 10% of France's GDP (What Is The French Fab?, n.d.). Furthermore, recent technological advances have decreased hardware production costs and increased the hardware industry's global connectivity - spurring an increase in the founding of hardware-focused startup companies (DiResta, Forrest, Vinyard, 2015). As more hardware startups are established in France, investors are beginning to take notice. In December of 2018, French venture capitalist firm Hardware Club invested 44 million euros in hardware startups (French VC Firm, 2018). As private investment continues to accumulate, confidence in the French hardware startup market is increasing.

Technology startups can work on either digital or physical products, with the latter classified as hardware startups. While the number of hardware startups are increasing, these companies still face difficulties (DiResta, 2015). As Andrew Thomas, founder of the profitable hardware startup Skybell stated, "hardware is hard" (Thomas, 2018). Hardware startups have higher costs and a much more difficult product development process compared to software or service-based startups (Thomas, 2018). Developing a prototype, which is essential to gauging market interest and receiving outside funding, requires space, access to machinery, specific technical knowledge, and connections with manufacturers. Hardware startups must react quickly to the ever-changing technological market that they exist within, yet altering their prototypes costs, a substantial amount of time and money. This added challenge can be met through resources that help reduce the risk of failure and connect the startup to valuable networks of funding, mentorship, prototyping machinery, and manufacturers (Wiggins, Gibson, 2003).

With the upsurge of hardware production and innovation, there is a growing need for a program that assists early-stage hardware startups achieve their goals. Bel Air Camp, a startup community center in Lyon, was created to foster the growth of hardware startups in the Rhône-Alpes ecosystem. Bel Air Camp runs an Accompagnement Program to advise hardware startups

through the difficult product development process. As the Accompagnement Program comes under new management, it must meet the demand for hardware startup services in its ecosystem. If the program is not aligned with the current ecosystem and does not provide the most valued product and business development resources, it will not be successful in the future.

The mission of this project was to formulate a recommendation for the management of the Accompagnement Program that will better position the program with the hardware startup ecosystem in the Rhône-Alpes region while providing the resources most valued by early-stage hardware startups. To complete this mission, we developed three objectives:

1. Evaluate the needs and current resources of hardware startups within France.
2. Assess the current use and operation of the Bel Air Camp's Accompagnement Program within France's startup community.
3. Compare the needs of the French startups with the Accompagnement Program's provided resources and current processes to evaluate the effectiveness of the program.

The accomplishment of these objectives resulted in a holistic yet specific understanding of what kind of program would be most successful in helping hardware startups to guide the reconfiguration of the Accompagnement Program under its new management.

2.0 Background

This chapter describes hardware startups and their challenges, the Rhône-Alpes ecosystem for hardware startups in France, and the resources available to help hardware startups overcome these challenges such as Bel Air Camp's Accompagnement Program, 1KUBATOR, and Kickmaker. These resources provide broad context and background for this project, which is concerned not only with the Accompagnement Program but the programs for hardware startups in Lyon, France.

2.1 Hardware Startups

Hardware startups are a subcategory of startups, distinguished by the fact that they produce physical products, as opposed to a non-physical product like software or financial technology (Stock, Seliger, 2016). The hardware could be a solely mechanical product, or a combination of mechanical, electrical, and software technology.

Hardware startups have all the needs and characteristics of general startups, with the additional challenge that they need to build physical prototypes of their ideas. Building these prototypes requires the use of processes and resources which are not necessary for other types of startups. Hence, hardware startups face unique needs as they have a product development process that is different from other startups. These needs must be addressed by a unique network of resources.

2.1.1 Product Development Process

The product development process is the method by which hardware startups turn ideas into prototypes and finished products. It begins with the *ideation stage*, in which the creator thinks about the product he or she wants to create and identifies the problem at hand. Creators often ask future customers for their input and alter their designs to meet the needs of the customers. Once this is completed, the hardware startup advances to the *prototyping phase*, in which they create mockups of the physical product to test its functionality and aesthetics. The creator refines the prototype based on testing and customer feedback before finding resources to mass-produce the product. Finally, the startup finalizes the design and *manufactures* it. The product development process includes additional steps such as funding, brand creation, and marketing, but our project focuses primarily on the main stages described above.

The prototyping process involves many potential challenges, which hardware startups handle differently according to their product and experience. Similarly, each hardware startup resource center provides different services based on its source of expertise.

As hardware startups go through their individual product development processes, it is important to understand what parts of the process were most challenging and required the most assistance. Their cost and time constraints depend on the concept and technology behind the prototype that they are developing.

2.1.2 Challenges

A study done in 2018 discusses the need for a new style of hardware and business development. With the advent of hardware-related products and technologies, the "entry

threshold" in this market has been lowered (Nguyen-Duc, Weng, Abrahamsson, 2018). However, this has simultaneously increased the competition within the startup market.

Hardware startups have two main concerns and challenges. First, to meet the fluctuating demand of consumers, time-to-market is a major concern for most hardware startups. Second, markets change quite quickly, and product development needs to be agile enough to adapt to changes in the market (Nguyen-Duc et al., 2018).

Both challenges have their own business and engineering difficulties, although Nguyen-Duc, Weng, and Abrahamsson have identified that the larger issue resides with developing products in an agile and quick manner. Yet, this process is very difficult for many hardware startups.

Additionally, one of the increasing challenges for hardware startups is the lack of income. For this reason, 29% of hardware startup fail (Evans, 2018). With the influx of interest and technology in startups, some get too caught up in the product development stage to remember to focus on the driving force behind any venture - the money. Mateo Carvajal, the Community Manager at the WCTI startup-incubator in Worcester, MA, also agreed with Evans. Carvajal stated startups are very conscious about the limited monetary resources they have (M. Carvajal, personal communication, March 28, 2019). Without the proper funding up front, a startup is bound to fail.

Hardware startups in France have additional challenges. French hardware startups could benefit from more preparation for scaling and internationalization (Jakubowski, 2017). France is a difficult environment for scaling up hardware startups. The cost of hiring employees is high due to social taxes, and financial regulations for offering stock options are discouragingly complex and make it difficult to increase the number of employees (Alderman, Morenne & Peltier, 2017). Such barriers can either prevent startups from growing past a certain point or incentivize them to move out of France (Alderman et al., 2017).

2.2 Hardware Startup Ecosystem

Recent increases in the number of hardware startups have led to the rise of a resource ecosystem focused on helping these startups conquer their challenges. The ecosystem comprises a network of entrepreneurs, organizations, and communities that support startups through each stage of their development and provide services to facilitate their success ("What Is Startup Ecosystem?", 2019). Within the ecosystem are *incubators, accelerators, investors, prototyping resources, and mentor organizations*. The ecosystem can provide *funding, legal assistance, advertising, marketing help, and manufacturing* ("What Is Startup Ecosystem?", 2019). The goal of the ecosystem is to connect hardware startups with resources to promote their success. Hardware startups can use resources on their own, simultaneously, or sequentially, depending on individual needs and what is available in the ecosystem (Etienne, Bloomin, personal communication, May 20th, 2019).

Due to recent upswings in hardware industries, the ecosystem's support infrastructure must adapt to meet changing needs. Efficient and cost-effective processes, spaces, and resources are all necessary to meet the challenges of producing hardware. Product development needs to be able to "react and adapt to unexpected and expected changes" within a fast-paced and uncertain environment (Nguyen-Duc et al., 2018). To accomplish this, the ecosystem's resources must

optimize their processes to foster agility in hardware startups. The resources additionally need to refine their expertise in industrializing products, since there is limited knowledge about scaling up and internationalization (Jakubowski, 2017).

2.2.1 Types of Startup Eco-System Resources

Incubators are programs which assist startups with their business development, generally also providing an office space. An incubator is useful for young hardware startups as they will need help building a business model for product development in later stages, marketing to attract potential customers and investors, and creating a website.

Accelerators are resources geared towards hardware startups in later stages, once they already have a business model. As such, startups will often graduate to an accelerator after using an incubator for the initial setup of their company, though having been in an incubator is not a requirement for joining an accelerator. As the name implies, accelerators expedite the development of a company, via a set duration of around three or four months in which some assist a hardware startup in acquiring capital and creating a Proof of Concept (POC) or a rough prototype. Startups can then pitch their ideas to investors in order to obtain more funding for further iterations of their prototypes and preparations for manufacturing (Zajiceck, 2017).

Both accelerators and incubators address the critical issue of funding by directing startups to potential investors. The incubators and accelerators also provide an initial source of capital, often in exchange for equity in the company. Dave Evans, a writer for Forbes and a CEO of his own startup, said 29% of hardware startup failures occur due to a lack of cash (Evans, 2018). While a lack of funds is a difficulty common to all startups, it especially plagues hardware startups.

Makerspaces are workshops which offer the use of a variety of tools, including 3D printers, CNC machining, and soldering, in exchange for a subscription fee (Maycotte, 2016). Prototyping, which is an inevitable necessity to build a working hardware product, requires access to expensive, specialized machinery, hence the value in makerspaces. Since hardware startups typically lack the capital to outright purchase prototyping equipment and start out working on a very small scale, this need-based system is a much more cost-effective option to experiment with their prototypes.

2.2.2 Mega-Platforms in France

In France as elsewhere, the various types of hardware startup resources are often combined into larger installations, known as mega-platforms.

These mega-platforms encompass large communities of startups and provide multiple services to support them. For example, mega-platforms such as Station F in Paris and Eura Technologies in Lille support several hundred startups. A smaller-scale mega-platform is Bel Air Camp, located in Lyon. Essential qualities of a mega-platform are a physical space for coworking, a community environment of cooperative competition, and a selection of support services such as prototyping or business advising.

While these mega-platforms can have very different focuses, such as business, social-business, and non-profit, they all tend to be large networks in order to spread their fixed costs efficiently across a collection of organizations. The mega-platforms have a strong relationship

with their geographical area, with local authorities helping to finance innovation and their networks helping to modernize and uplift their local communities. Evaluating the precise impacts of the mega-platforms on their surrounding areas is currently a growing area of research.

Please reference the map (Figure 1) below which depicts the 14 mega-platforms in France (Merindol, Versailles, 2018).

Figure 1: Map of mega-platforms located within France, including Bel Air Camp. Retrieved from Merindol, Versailles, 2018.

Le Tuba and You Factory are both located in Lyon and identified in the map in Figure 1. Le Tuba is a coworking space and You Factory is a makerspace that provides specialized support and services to hardware startups.

In addition to the resources on this map, new mega-platforms have been opened in France, including H7, a mega-platform in Lyon. H7 brings different startups together so they can benefit from each other's area of expertise.

2.3 Bel Air Camp's Accompagnement Program

In Lyon, Bel Air Camp, a company founded in 2016, is one of the Rhône-Alpes region's mega-platforms. Located in Villeurbanne, the largest suburb in the metropole of Lyon, Bel Air Camp has a 34,000-square-meter space dedicated to building a community of startup companies. Since opening, Bel Air Camp has hosted 50 hardware startups, totaling 352 people. The proximity allows the startups to network and share ideas amongst each other, while also having their own personalized workspaces.

The Bel Air Camp facilities include the Tech Park, a workshop with access to prototyping equipment, technical education, and fiscal resources. The Tech Park also runs an Accompagnement Program which offers more specific guidance for prototyping. The program is run by the Manager of the Tech Park, Jean-Alexandre Bousquet. Since the program only has one worker, Jean-Alexandre Bousquet, the knowledge about tools and prototyping available to the program is based off his expertise.

The goal of the Accompagnement Program is to assist hardware startups in turning their ideas into prototypes. The first stage of the program is to develop a Proof of Concept (POC), an initial design which demonstrates that the base idea is feasible. The next stage is to iterate through the prototyping process while getting feedback from customers. Finally, they produce a mini série of several finished units of their product to sell and gain some funds. Once hardware startups complete these stages, they will be ready to move into manufacturing. The program is currently run by Jean-Alexandre Bousquet in partnership with two other companies, 1KUBATOR and Kickmaker.

2.3.1 Relationships with 1KUBATOR and Kickmaker

Since the Accompagnement Program is a part of the hardware startup ecosystem, it has connections with other resources. The program currently has two notable connections with 1KUBATOR and Kickmaker. 1KUBATOR is a local incubator which provides 12,500 € in cash as well as 12,500 € in services such as office space and website development to startups in exchange for 10% equity in their company (1KUBATOR, n.d.). 1KUBATOR is not exclusive to hardware startups and does not have an internal prototyping service. Instead, its partnership with Bel Air Camp connects hardware startups to and provides funding for part of the Accompagnement Program. This way, 1KUBATOR's hardware startups receive guidance for both business and prototyping.

Kickmaker was founded in Paris in 2016 as an engineering company that specializes in helping hardware startups to industrialize their products. Now well-established in Paris, Kickmaker is a more recent addition to the hardware startup ecosystem in the Rhône-Alpes region, with an office located within Bel Air Camp.

Like Bel Air Camp's Accompagnement Program, Kickmaker is a resource for hardware startups. Kickmaker leverages technical expertise to bring startups through a phase of product development, but it has focused on a later stage of that process. The Accompagnement helps to transform ideas into prototypes, whereas Kickmaker works with startups that already have prototypes to help them successfully mass-produce, through connections with manufacturers in China. These relations are important since the Accompagnement Program will have partnerships with these resources to provide services to hardware startups.

2.3.2 Bel Air Camp-Kickmaker Partnership: Kickmaker Assembly Line (KAL)

As of June 2019, Bel Air Camp and Kickmaker are entering into partnership in a new initiative, the Kickmaker Assembly Line (KAL). The KAL will focus on the production of a *présérie*, or a limited run of manufacturing. The préserie is important for hardware startups since it allows them to test production on a scale larger than a single prototype, but smaller than mass-manufacturing. Making a préserie also gives startups an inventory which they can sell to finance later stages of their process ("KAL Kickmaker Assembly Line", 2019). The KAL will have two locations, one in Lyon and the other in Paris (already established). Bel Air's Tech Park will provide the location for the Lyon branch of the assembly line ("KAL Kickmaker Assembly Line", 2019). Kickmaker will manage the Accompagnement Program while Bel Air Camp's staff will focus on other initiatives.

Since Kickmaker currently does not offer services for hardware startups at their earliest stages and the Accompagnement Program has been underutilized, the effective integration of such services at all stages of development is a promising context for this project and for the new initiative to meet the needs of the hardware startups. The importance of our study was amplified when it became a priority to position the KAL program strategically within the Lyon hardware startup ecosystem. In order to position the program in the ecosystem, a methodology was created to gather and analyze hardware startups needs and assess the Accompagnement Program.

3.0 Methodology

The goal of this project was to assess the use of Bel Air Camp's Accompagnement Program and propose means to improve its fit within the Rhône-Alpes hardware startup ecosystem as it acquires new management through Kickmaker. This will improve the new program's ability to assist hardware startups.

The conceptual focus of our project was hardware startups, or small entrepreneurial companies which produce physical products. Large, well-established companies and non-hardware startups were not included in our scope since they would not have a need for the program. To accomplish our goal, we developed three main objectives. The sections that follow describes our methods for each objective. These objectives were to:

1. Evaluate the needs and current resources of hardware startups within France.
2. Assess the current use and operation of the Accompagnement Program within France's startup community.
3. Compare the Accompagnement Program with the needs and challenges of hardware startups.

3.1 Evaluate Challenges, Resources, and Strategies for Startups

In this objective, we investigated the hardware startup ecosystem of the Rhône-Alpes in order to identify the challenges experienced by hardware startups, the resources available to them, and the strategies that startups use to determine if these resources are worth their time and money.

3.1.1 Hardware Startups

The hardware startups themselves were a critical source of firsthand information about the issues they face and the resources they use to overcome those challenges. We gathered qualitative data about their challenges and strategies through semi-structured interviews, which allowed us to compare answers while having the freedom to explore new ideas (Solovey). We interviewed hardware startups within Bel Air Camp and through connections of the Bel Air Camp Community-Building Manager.

During the interviews, we inquired about the startups' milestones, acquisition of funding, resources used for prototyping, and greatest challenges. This information informed us about the needs of hardware startups and their valuation of resource centers. Afterwards, we sent a follow-up questionnaire to each company in order to obtain additional data and to standardize the responses by asking a consistent set of questions. Reference Appendix A for the questions prepared for the interviews and Appendix E for the follow-up questionnaire.

To gather data from a wider variety of startups, we created an online survey. The survey asked about the startups' background experience, usage and knowledge of ecosystem resources, and opinions on which types of programs were most valuable. The survey illustrated a larger section of the ecosystem and reduced bias from the interviews by collecting data from a broader demographic. Please reference Appendix D for the complete survey.

3.1.2 Resource Centers

In order to map the network of resources available for startups in Lyon, we conducted semi-structured interviews with startup resource centers. We used Bel Air Camp's connections with other resource centers to set up interviews. When speaking with the resources, we had to be careful about preserving the image of our project partner and maintaining a stance of neutrality, which limited the range and phrasing of questions we could ask.

3.2 Examine the Accompagnement Program's Resources

We examined the current structure and resources of the Accompagnement Program, as well as perceptions of it within Bel Air Camp and the wider startup ecosystem. For information about the structure and resources, we interviewed the manager and employees of the Tech Park. For outside perspectives, we included questions about the Accompagnement Program in the interviews and survey described in Section 3.1.

Throughout our time at Bel Air Camp, we were in contact with the manager of the Tech Park, Jean-Alexandre Bousquet. As the manager, he was the most knowledgeable source of information about the processes and participants of the Accompagnement Program. We conducted short interviews every few days to ask about the Accompagnement Program's structure, methodology, pricing, expertise and connections with external resources.

To examine the customer perspective, we interviewed the startups currently participating in the Accompagnement Program. We asked the participants about their experiences with the Accompagnement Program, their reasons for using the program, and which aspects they found most helpful.

3.3 Compare the Accompagnement Program with Startups' Needs

In this objective, we compared the needs of the French hardware startups with the Accompagnement Program's current resources and processes in order to evaluate the effectiveness of the program and to make recommendations for the future management of the Accompagnement Program. To compare the needs hardware startups to the resources, we first analyzed the data that was gathered in Section 3.1. We used interview coding to extract key takeaways about hardware startups challenges and resource usage from the interviews. We then analyzed the survey results via Excel to gather the results in the areas we had designated as most important based on the interview findings. We then determined trends and characteristics for startups' resource usage through a comparison of the interview coding and survey results.

To analyze the results from Section 3.2, we ranked the skills, knowledge, and connections of the current Accompagnement Program, based on conversations with the Tech Park manager. To compare these ratings to the findings from 3.1, we performed a Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis of the Accompagnement Program, which provided a holistic overview of the current program and its future possibilities. This SWOT analysis provided a basis for our recommendations.

4.0 Evaluation of the Needs and Resources of Hardware Startups

We analyzed the data gathered from interviews and survey to determine the needs of hardware startups in the Rhône-Alpes region. We interviewed 11 hardware startups and four resource centers. These interviews guided the creation of the hardware startup survey. The survey was distributed via email to 115 hardware startups, which we found through Bel Air Camp, a local university incubator Beelys, the Hublo startup festival, and online databases. Bel Air Camp also posted the survey to their LinkedIn network. We received 41 complete responses and 14 partial responses. The partial responses were used in the analysis of individual questions, but not counted in cross-analyses of questions which they did not answer. Three additional responses came from software startups and were not included in the analysis. The sections below present conclusions we made from the analysis of the survey and interviews that we conducted.

4.1 Each Startup is Different and Will Have Different Needs

During the interviews, we asked hardware startups about their founders and their startup's storyline. Interviewees talked about the founders' level of experience, knowledge, and connections. Similarly, they discussed the steps that the startup took to get to its current stage. Through these 11 interviews, we learned that each hardware startup had a unique storyline and each startup's founders had varying levels of experience, connections, and knowledge. Our survey data also reinforces the finding that each startup is unique and has different needs.

To determine each startup founder's level of experience and knowledge, the survey asked respondents if the founders had experience or education in six different areas: engineering, management, marketing, entrepreneurship, finance, and startups. In Figure 2, it is apparent that there is no real grouping in the experience level of founders; the responses are scattered, showing there is no pattern to a founder's experience.

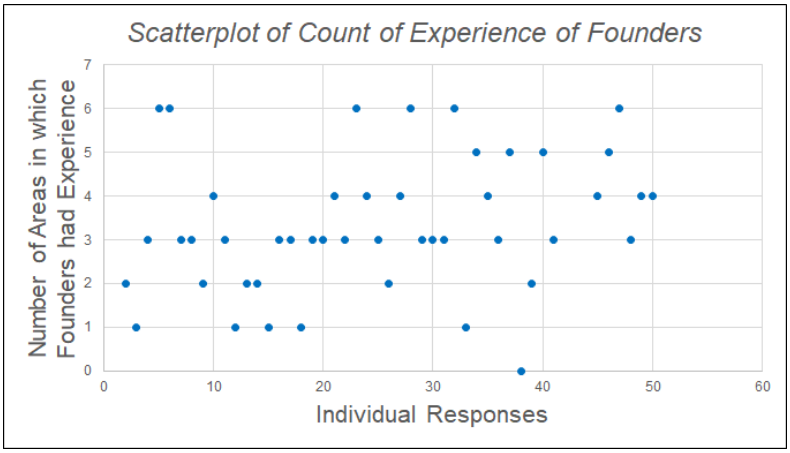

Figure 2: Scatter Plot of Count of Experience of Founders to illustrate the varying levels of experience between survey responses, n=50.

We also asked hardware startups to rate their level of knowledge of product technology, connections with manufacturers, and connections with business development on a scale of

limited, moderate, and strong (reference Appendix D, question 10). As shown in Figure 3, each area had a range of answers. While there did seem to be more strong connections with manufacturers and more limited connections with business development and knowledge of product technology, these differences were not considered significant.

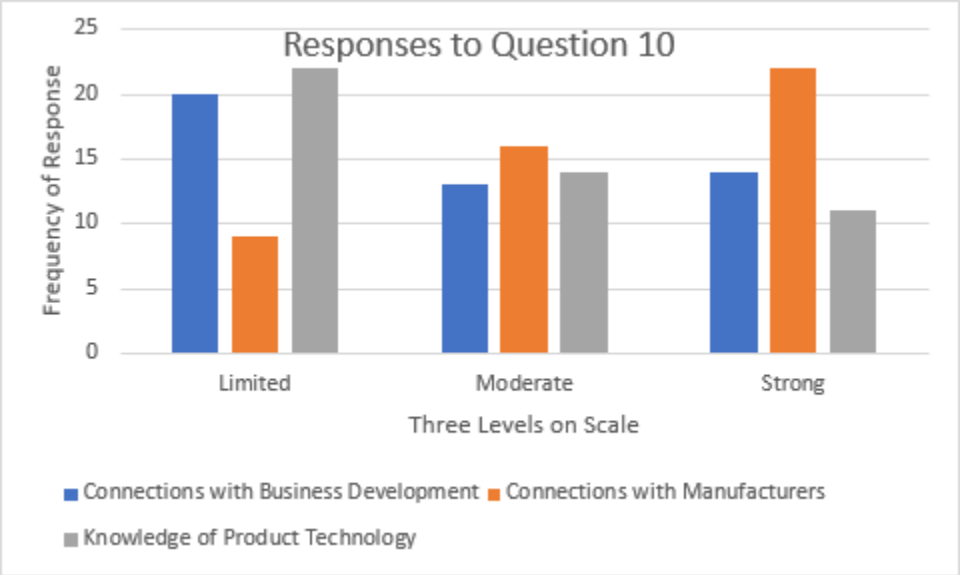

Figure 3: Clustered color chart of the level of knowledge of product technology, connections with business development, and connections with manufacturers of the startup founders, n=47.

Furthermore, we asked respondents to organize a list of milestones into the order in which they occurred for their startup.

	Frequency of Milestone	
When Milestone Occcured	Received Potential Customer Feedback	First Gained Funding
1st	2	3
2nd	5	5
3rd	9	4
4th	4	3
5th	3	5
6th	3	3
7th	3	5
8th	2	2
9th	0	0
10th	1	0
11th	1	0
12th	0	0

Figure 4: Gradient chart of the frequency of milestone occurrence, n=48.

Some milestones happened at a consistent point in the startup's timeline; for instance, 'Received Potential Customer Feedback' was often the third milestone reached. However, other milestones like 'First Gained Funding' did not occur in any consistent order, demonstrating that each startup has a unique path of development (reference Figure 4). See Appendix F.1 for more data on milestones.

4.2 Startups Do Not Want an All-Inclusive Program

In our interviews with hardware startups, we noticed that there were a variety of responses for a program that offered all the services. Hardware startups four and nine (reference Appendix B) were hesitant to join a program that provides all services because they were concerned that the program might provide services they didn't need. Meanwhile, hardware startup two started they were interested in a program that helped with every stage. There were a variety of other answers that expressed interest in incubators and other resources, but only one stated they would use a program that offered all services. In the interviews, we didn't ask questions about the pricing for these programs - *prix fixe* or *à la carte* - since this did not appear to be relevant at the interview stage of the project (reference Appendix D, questions four and five). Therefore, the survey question we developed to gather more information on all-inclusive programs also didn't clarify between payment methods.

In the survey, only 34% of the respondents were using or planned to use a program with all the elements, and 41% were uninterested in such a program (reference Figure 5).

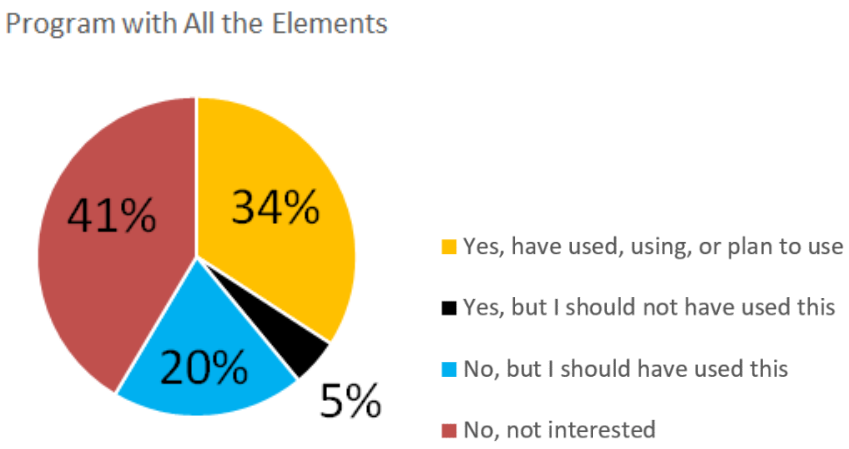

Figure 5: Graph of interest in a program with all the elements, n=42.

Based on our interview findings, we had expected that more respondents would be uninterested in a program with all the elements. This discrepancy could be ascribed to a lack of clarification as to whether the question referred to an *à la carte* or *prix fixe* program. In hindsight, we would have put a clarifying question in the survey. However, when comparing the responses for any given individual element, there was lower interest and higher disinterest in a program with all the elements (reference Appendix F.2). This indicates that for each individual element, there were startups who wanted that service but did not want a *prix fixe* program with everything.

We investigated this point through follow-up questions which explored price ranges and interest in the all-inclusive program. Of the 41% of uninterested startups, 62% of them said a program with all the elements wasn't relevant to their hardware startup or that they did not need this assistance, reinforcing the conclusion that startups only want specific services rather than an all-inclusive *prix fixe* program (reference Figure 6).

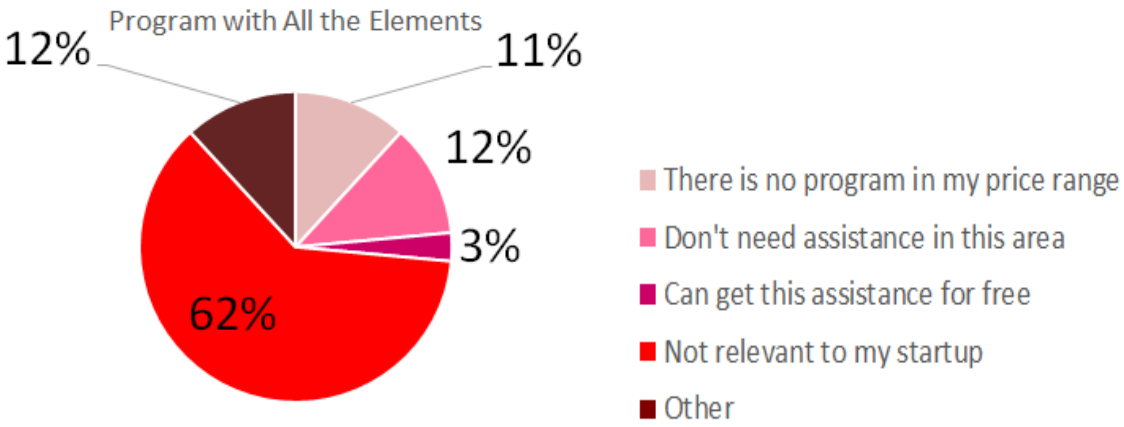

Figure 6: Why startups were uninterested in using a program with all the elements, n=17.

While 37% of those who wish they were involved in a program with all the elements said they did not know that such a program existed, 25% of them were discouraged because of cost or because they did not need all the services (reference Figure)7.

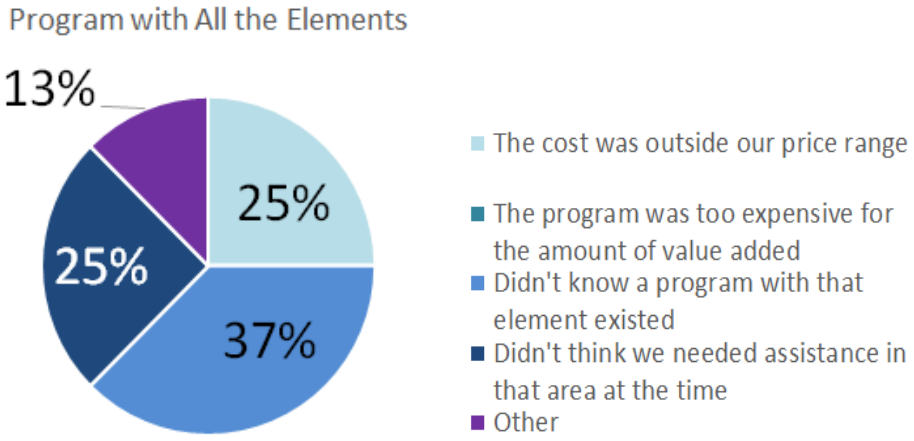

Figure 7: Why startups originally chose not to use a program with all the elements. n=8.

These findings indicate that hardware startups will use a resource that is relevant and cost effective. A *prix fixe* program will not fit these requirements. In the *prix fixe* program, a startup will be paying for the program that is not relevant, therefore it is not cost effective. The ability to choose specific services allows startups to meet their needs cost effectively.

We used the case study of the Austin Technology Incubator to help with our analysis. In the case study, it was stated that incubators are most successful when they provide a few select resources and focus on providing the best services (reference Appendix G). Therefore, a program that helps a startup in all areas is not valuable since the program will be stretched too thin and not offer valuable services.

4.3 Hardware Startups with Different Experiences Need Different Resources

We divided the startups based on their experience level in order to compare them. There were 28 hardware startups that had experience in three or less of the areas and 13 hardware startups that had experience in four or more of the areas. The areas were: Engineering, Management, Finance, Marketing, Startups, and Entrepreneurship. The comparison in Figure 8 shows that startups with less experience were 35% more interested or had been involved in more services than those with more experience.

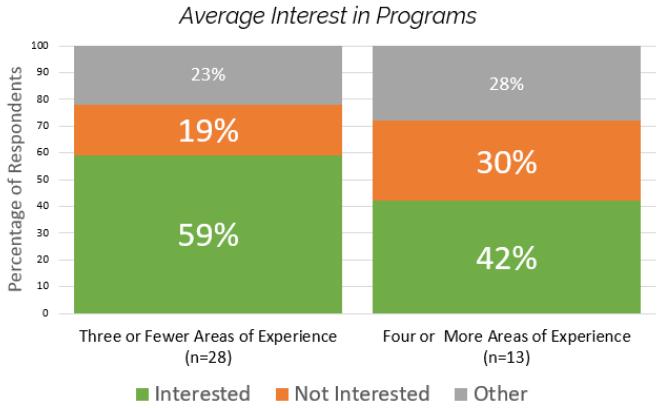

Figure 8: Usage of and interest in a program with all the elements, based from experience and interest in program. n=28 and n=13.

Similarly, hardware startups with more experience were also more likely to be uninterested in services (30% to 19%). Lastly, startups with more experience were more regretful of being involved in services in the past (13% to 5%). Interviews with hardware startup three and six helped explain the results of the survey. They were convinced that to scale up their startup, they needed business, manufacturing, and fundraising assistance. However, they were not interested in a program that helped them develop the POC or prototype since they were experts in that area. Since these hardware startups had enough knowledge that they did not need all the resources in the ecosystem. When they did need a resource, they were both interested in a service that was the best at what it did. They said that they needed high-end 3D printers and laser cutters as they were working on developing advanced technology (reference Appendix B).

Meanwhile the startups with limited experience were willing to use more resources. Young entrepreneurs might have one area of expertise, but not enough in other areas to be successful. This was demonstrated through the interview with Beelys, an incubator for entrepreneurs in college. For instance, the engineers needed business help while business majors needed help learning how to use the prototyping tools. This was confirmed during interviews with a young entrepreneur. He felt he did not know enough, and so he used all the resources, but cost was as important factor in deciding what to use. Since there are more knowledge and skill gaps, the resources must provide services that can help hardware startups with different areas of knowledge. These findings support two conclusions: hardware startups with considerable experience need specific and high-quality services; hardware startups with limited experience need broad, more cost-effective services.

4.4 Startups will use Multiple Resource Centers

When interviewing hardware startups, it was apparent that each relied on multiple resources during their product development process. All the hardware startups we interviewed received outside help in a cost-effective manner. We found that the founder of hardware startup nine used close friends of his that had immense knowledge of the product's technology to save money. Many startups also use resource centers within the ecosystem.

Our interviews with startup resource centers Kickmaker, Piwio, 1KUBATOR, and Beelys confirmed these results. Each resource center had connections with other resource centers in the area, like BoostInLyon or French Fab (reference Appendix H). The resource centers would frequently recommend other resource centers to its own hardware startups when it couldn't meet their needs. For instance, hardware startup nine joined an incubator to gain connections to other resource centers, which is how it formed its connection with Bel Air Camp (reference Appendix B). Furthermore, the centers frequently had clients that used multiple resource centers at the same time. For instance, Beelys provided mainly business incubation and workshops, put partnered with other outside resource centers to provide more specialized assistance.
In the survey, we were most curious about the usage of legitimate hardware startup resource centers, not including the use of friends and family. Of the 41 complete survey responses, 59% of them used two or more resource centers like incubators, accelerators, or consultants.

Lastly, Austin Technology Incubator makes an interesting point about how to be a successful resource center. Focus on offering a few specific high-quality services (reference Appendix G). Hence, it's logical to expect startups to use more than one resource center to be sure they are getting the best service for them at the right price and quality.

4.5 Hardware Startups Value their Reputation and Image

Through our interviews, we determined that a well-connected hardware startup will have better access to resources and is more likely to receive attention from investors or potential customers. For example, hardware startup two joined Bel Air Camp for the primary purpose of developing its reputation and image to receive funding (reference Appendix B). Hardware startup nine's primary motivation to join the incubator was to gain accreditation in the ecosystem.

According to our survey results, the most common reason hardware startups chose to use resource centers was to obtain resources and connections they could not get on their own or to improve the reputation of their startup, 36% and 23%, respectively (reference Figure 9). Only 10% of the respondents chose a resource because they were unable to continue the startup without it and had no other feasible options. Hence, we can conclude that value hardware startups connections and reputation over other more tangible means. If they do not think the program has this value, they will move on.

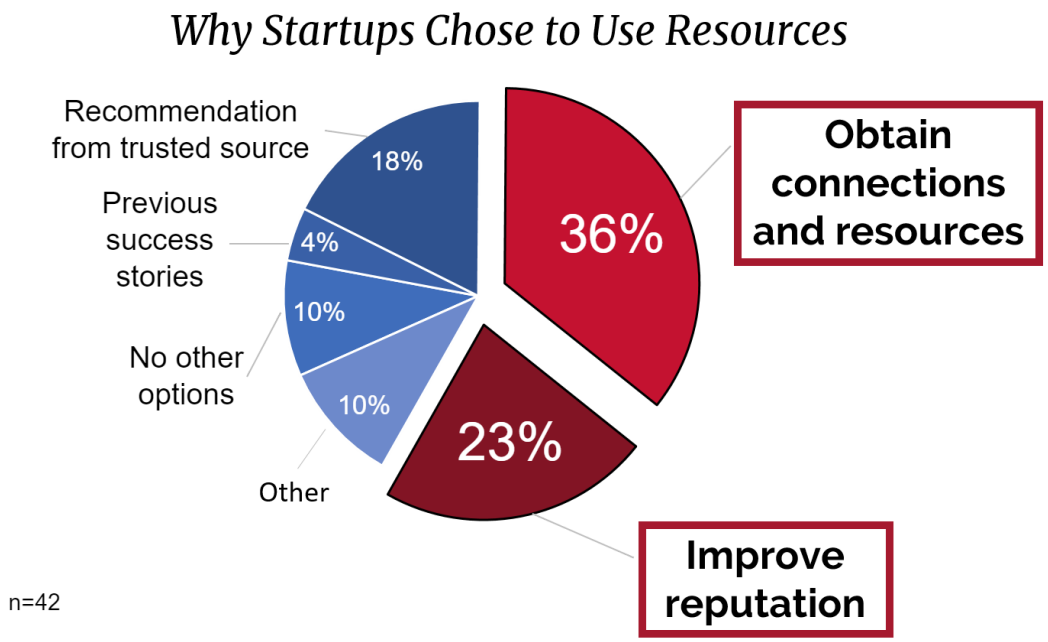

Figure 9: Why startups chose to use resources, n=42.

4.6 Acquiring Funding is Hardware Startups' Greatest Challenge

Through our interviews and surveys with hardware startups, we learned that funding is one of the greatest challenges they face. In our survey, the most common challenge hardware startups faced was acquiring funding, with 38% of the respondents selecting it as their greatest challenge (reference Figure 10 below).

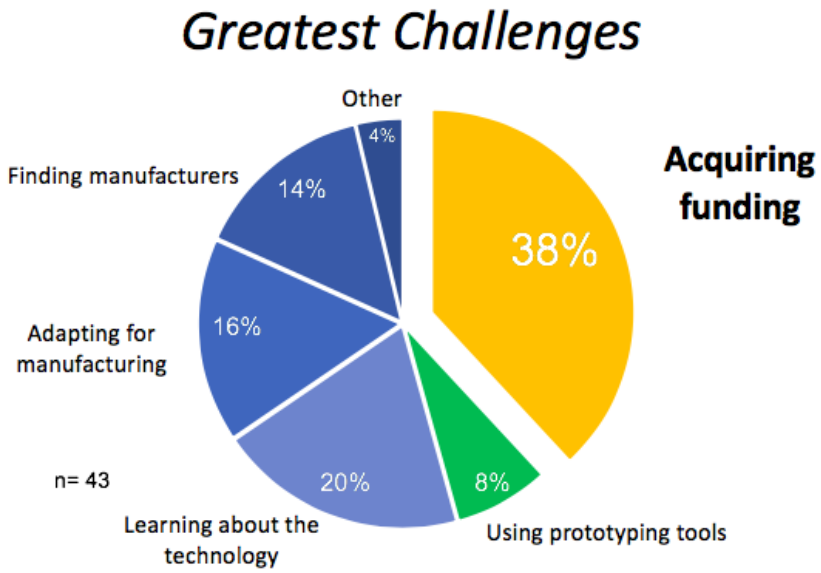

Figure 10: Funding is the greatest challenge for hardware startups.

Even though the government provides funding at earlier stages of product development, our interviewees indicated that it is harder to get funds once hardware startups get close to mass-production as there is uncertainty about what will come next. Due to this, our survey results

show that most hardware startups also want to acquire funding through the help of a program that they are part of. Across the milestones in the product development process, we asked hardware startups how they would be willing to pay for them and noticed a trend for funding acquired through program (reference Appendix F.2).

5.0 Accompagnement Program

This section describes our assessment of the Accompagnement Program, which we conducted through our own observations, interviews with the Tech Park personnel, and questions in our interviews and survey of hardware startups. We first examine the program structure and its partnership with 1KUBATOR, rate the program's capabilities, and discuss opinions on the program. We then compare the needs of hardware startups, as determined in Chapter 4, to the current program. We conclude with a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the Accompagnement Program's positioning within the ecosystem.

5.1 Program Structure

The Accompagnement Program is structured with four main bricks: methodology, expertise, networking, and space. The methodology includes three stages: Proof of Concept (POC), prototyping, and mini série. These stages are priced individually: €1,200 for POC, €2,500 for prototyping, and €4,500 for the mini série. To begin the product development, the Tech Park manager creates a Gantt chart which includes about two months for the POC stage, four to five months for prototyping, and five to six months for the mini série. To discuss problems and ideas as they come, hardware startups have creativity sessions with the manager of the Tech Park.

Accompagnement Program participants can optionally get access to business or software development services by joining 1KUBATOR as part of the partnership known as 1KFABRIK. Similarly, 1KUBATOR directs its hardware startups to the Accompagnement Program for prototyping services. For the 1KFABRIK program, 1KUBATOR offers €25,000 in exchange for 10% of equity in the startup. Half of this money goes towards software, application, and business development services, while the other half is split between paying for the Accompagnement Program and going to the startup as cash. The Proof of Concept (POC) is paid for by 1KUBATOR if a hardware startup is part of it as well, so being in the partnership program (1KFABRIK) is cheaper than just being part of the Accompagnement Program at Bel Air Camp. The 1KFABRIK program also integrates design thinking by connecting startups to consumers to get feedback on their POC and prototypes.

The second brick, expertise, focuses on skills which the hardware startups lack. The manager of the Tech Park helps them with mechanical design related tasks and finds experts to assist in other engineering areas. The cost for the external expertise depends heavily on the technical specifications for each product, so it is not included in the base price of the program.

The third brick is the manufacturing network, used for prototyping and the mini série. Most of the manufacturing is done by small machine shops or craftsmen. The mini série is the production of a small quantity of the product that could help a hardware startup make some money. As the two hardware startups currently part of the Accompagnement Program have not yet reached the mini série stage, we do not have specific information on how that process works.

The last brick is the space. Hardware startups within the Accompagnement Program have access to Bel Air's Tech Park and a separate office space dedicated to the 1KFABRIK program.

5.1.2 Rating of Capabilities

By evaluating the knowledge and resources of the Accompagnement Program, we determined that the program's primary strengths are its mechanical background, prototyping knowledge and machinery, and project management. The program also has strong connections, including the 1KFABRIK partnership and the upcoming collaboration with Kickmaker. The areas in which the program is lacking are knowledge of specialized, non-mechanical areas such as electronics, and connections to large-scale manufacturing. Reference Appendix C for detailed ratings.

5.1.3 Opinions of Hardware Startups

We gathered opinions on the Accompagnement Program through our interviews and survey of hardware startups. The interviewees agreed that the Accompagnement Program met some needs of companies, such as prototyping and mechanical design help, but did not fulfill other needs.

The startups using the program were generally satisfied, while outside startups were more critical of the program. The participants thought the industrialization process and assistance could be improved, and that the workspaces should be open for more hours. Outside hardware startups commented on the lack of quality machines, and the need for more industrialization and business help.

Survey responses indicated that startups felt that the Accompagnement Program was overpriced, and that many hardware startups did not join because they had passed the prototyping stage by the time the program was founded.

5.2 Evaluating Effectiveness of Accompagnement Program

This section compares the needs of the French hardware startups with the Accompagnement Program's provided resources and current processes in order to evaluate the effectiveness of the program. We first used the analysis from Sections 4.1 and 5.1 to evaluate the program's positioning within the Rhône-Alpes startup ecosystem. Secondly, we performed a SWOT analysis of the program to inform our recommendations for how to better assist hardware startups.

5.2.1 Direct Comparison

In this section, we compare the needs of hardware startups in the Rhône-Alpes region with the Accompagnement Program's resources and current processes to evaluate the effectiveness of the program. The analysis revealed the gap between the needs of hardware startups and the program's provided services.

5.2.1.1 Accompagnement Program Satisfaction of Needs

We identified the needs of hardware startups that the Accompagnement Program currently satisfies. Table 1 below summarizes the needs of hardware startups and the program's means of addressing them. Payment for the program stands out as an important challenge; we will discuss it further in Section 5.2.1.2.

Need	**Support**	**Current Accompagnement Program**
Structured Project Methodology	• 55% of the survey respondents interested in such a program	• 4 bricks of program and the methodology (POC, prototyping, mini série) meet this need ○ Manager of the Tech Park has a Gantt chart for methodology

Pay for program with outside funding or funding through program	• 25% of those interested in business development help willing to pay with equity
	• 60% of hardware startups expressed interest in a program that helped with POC
	  ○ 34% would want to pay with either equity or outside funding.
	  ○ 17% would pay via funding acquired through the program
	• Of the respondents interested in Structured Project Methodology:
	  ○ 23% would pay using funds obtained through the program itself
	• 37% of those interested in prototyping help would pay with equity or outside funding
		• Funding through partnership with 1KUBATOR (€ 25,000 for 10% equity). € 12,500 go to 1KUBATOR for its services and the rest can be used to pay for prototyping and mini série at Bel Air Camp.
		• Outside funding is focused on in 4.3.1.2

Prototyping	• Hardware startups we interviewed have built a prototype to get funding/ feedback from customers • From our survey, 62% respondents expressed	• 4-5-month prototyping service as part of the Accompagnement Program • Mechanical design need met as Manager of Tech Park is an expert

	interest in using a prototyping service • 10% of survey respondents said they wished they used such a service	• Little electrical design and software development help (reference Table 2). Hardware startups we interviewed and surveyed use this tool in the development of their product. We will focus on this in 4.3.1.2
Business Development	• 71% of survey respondents said they use, plan to use, or should have used a service that helps with business development • 29 % of survey respondents not interested but as this is not a required part of Accompagnement Program, hardware startups can still take advantage of product development services	• Accompagnement Program's partnership with 1KUBATOR, 1KUBATOR provides business development services

Table 1: Hardware Startups needs met by Accompaniments Program.

Looking at the types of technology which startups use in their products, listed in Table 2, software and electronics are some of the most utilized technologies. The Accompagnement Program addresses the need for software development through the 1KFABRIK program, connecting startups with many software services. By contrast, the program lacks strong expertise in electronics, which it can mitigate through its upcoming partnership with Kickmaker.

Technology	Mean Response Value
Software/App Development	2.53
Electronics	2.51
Sensors	2.40
Mechanics	2.15
Plastics	2.13

Table 2: Mean responses for how much each type of technology is used in the respondents' products, on a scale of 0 to 3, with 3 meaning that the technology is very important to the product. Reference Appendix F.9 for full table.

5.2.1.2 Gap Between Needs and Provided Resources

By comparing the needs of hardware startups and the Accompagnement Program, we determined the needs which the program does not fulfill. These needs were:

- Funding
- Networking and Marketing
- Connections with Customers
- Connections with Manufacturers

Some of these needs, such as connections with customers, are partially addressed by the 1KUBATOR partnership, but need to be better tailored for hardware in order to be truly effective. Other services are not offered at all, so the Accompagnement Program will either need to create new services or make connections to fulfill those needs. For instance, the partnership with Kickmaker can provide connections with manufacturers, and Bel Air Camp has considered creating a fundraising program which could partner with the Accompagnement Program. Refer to Table 3 for details on the needs and how they are being met.

Need	Support	Current Program
Funding	• 38% of survey respondents said that funding was the greatest challenge their startup faced • 73% expressed an interest in using a program to help with fundraising	Some funding is provided through the partnership with 1KFABRIK, but it does not fully cover this need. It can be improved upon by helping find funding for the hardware startups through Bel Air Camp.
Networking and marketing	• 20 of the 42 startups we reached out to have founders with experience in marketing • 76% of the survey respondents indicated that they were either currently involved, plan to be involved, or should have been involved in a program that provided marketing assistance • 59% of hardware startups joined startup resource centers for access to networks or to increase the startups reputation	<u>Networking</u> Being a part of Bel Air Camp and 1KUBATOR creates some ability to network, but it could be increased. Meanwhile, the Accompagnement Program does not offer any explicit marketing services, which the program should offer. <u>Marketing</u> The partnership with 1KUBATOR does assist startups when it comes to producing a website and offers marketing workshops, but hardware startups rarely have the time to attend these

	• 18% of startups joined a resource center because of a specific recommendation from one of their connections	workshops. Without any specialized or easily accessible marketing services, the Accompagnement Program is severely lacking in this aspect. Therefore, the program should increase the amount of marketing services.
Connections with customers	• 56% of the hardware startups surveyed are either using or interested in a program that connected them with customers and 25% said they should have used it	This need is partially fulfilled through the 1KConnect program, but the Accompagnement Program does not have a specific step to fulfill this need. Therefore, connections with costumers should be built into the program
Connections with manufacturers	• 66% of the hardware startups stated they were using or should have used a program that helped connect with manufacturers • Through interviews, product manufacturing is one of the hardest parts of the product development process	Currently the program has some manufacturing connections, and the partnerships with Kickmaker will help increase the connections. While improvements are being made, there is still a need to connect with manufacturers, which should be built into the Accompagnement Program

Table 3: Unmet needs of hardware startups.

5.2.2 Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

We evaluated the resource capabilities of the Accompagnement Program by asking the Tech Park manager about the knowledge, machines and connections available to the program. We rated each capability on a scale of 0 to 5, with 0 being no capabilities and 5 being expert level. We used this rating in the SWOT analysis. The entire list appears in Appendix C.

The SWOT analysis presents a holistic view of the Accompagnement Program, which assisted us in making recommendations. Strengths and weaknesses are internal aspects of the Accompagnement Program, whereas opportunities and threats are external aspects. Table 4 provides a detailed overview of each category.

Strengths	**Weaknesses**
• Startups can choose the brick they need help with	• No funding help for hardware startups

• Connection with Kickmaker for manufacturing • Partnership with incubator (1KUBATOR) makes program at Bel Air cheaper • The Tech Park Manager is an expert in mechanical design, can give good advice on project management	• Limited prototyping ability for electronics and other processes beyond mechanical • No workshops to teach how to use machines • Existing equipment not high end • Cost effective and time efficient to have own equipment than pay for use • Limited to no industrialization help or connections • Limited hours of Tech Park being open (closed over lunch, for example) • Limited value proposition prepared for future customers as too few companies in program to prove that the program works and limited success stories • Needs updated Gantt chart, more structure, and help with intellectual property • The Tech Park Manager is the only person to assist hardware startups
Opportunities • Partnership with Kickmaker can open up new connections, workers, and machine and knowledge • Attract hardware startups at early prototyping stage	**Threats** • Other incubators such as H7 are more well known to have better connections • The current outsource percent is about 90% of the time • Lyon does not have an easy network of resources to navigate, hard to have connections • Manager of the Tech Park claims engineers do not see the need for program • 1KUBATOR does not actively recruit hardware startups, and is not specialized for hardware

Table 4: SWOT analysis of Bel Air Camp's Accompagnement Program.

6.0 Recommendations

Within this section, we discuss the strengths of the Accompagnement Program that meet the needs of hardware startups in the Rhône-Alpes region. We then provide recommendations that will fill the gaps of the Accompagnement Program's offerings to bring in more hardware startups and improve the quality of the program.

6.1 Strengths of the Accompagnement Program

After comparing the Accompagnement Program to the needs of hardware startups, we identified aspects of the program which have a strong ability to meet these needs. The recommendations in this section describe the strengths which should be kept as the program comes under the new management of Kickmaker. At the time of writing this report, the particulars of the future Kickmaker partnership are in flux. Hence, recommending which aspects should be kept and describing how to integrate them into the future version of the program is essential for further success.

6.1.1 Individual Product Development Stages - POC, Prototype, Mini Série

The greatest strength of the program is its three individual product development stages; Proof of Concept (POC), prototyping, and mini série. The mini série is a limited run of production which allows hardware startups to generate some revenue by selling a few initial versions of their product. In our survey, the POC and prototyping were the first and second most common stages that hardware startups have completed; 83% of hardware startups had made a POC and 75% of them had begun prototyping (reference Appendix F.1 for the full distribution of occurrences). Since almost all hardware startups will be partaking in these stages, it is important for the program to offer these services. Furthermore, hardware startups can pick and choose which stages they would like to pay for in the Accompagnement program, catering the product development to the uniqueness of each hardware startup. For these reasons, we think the three individual stages of product development should be kept in the future program.

6.1.2 Prototyping Space, Mechanical Equipment and Knowledge

Our interviews with hardware startups indicated that the POC and development of a prototype are crucial to secure funding and receive customer feedback. To develop a prototype, hardware startups need access to prototyping machines and knowledge, which eight of the eleven hardware startups we interviewed did not have. For these reasons, we highly recommend that the Accompagnement Program keep its current prototyping technology. This includes the 3D printers and laser cutter, as well as the knowledge to use these machines effectively and efficiently. These machines allow hardware startups to quickly iterate through multiple prototype designs and ideas, without the cost of manufacturing the product, which is essential for hardware startups' success (DiResta, Forrest, Vinyard, 2015). To implement this recommendation, we think it would be best to keep a workshop-style area for the prototyping machines, with educated personnel to run them.

6.1.3 Business Development Support - 1KUBATOR Partnership

Of the 48 survey respondents, less than half had experience in startups or in finance, as illustrated by Figure 11.

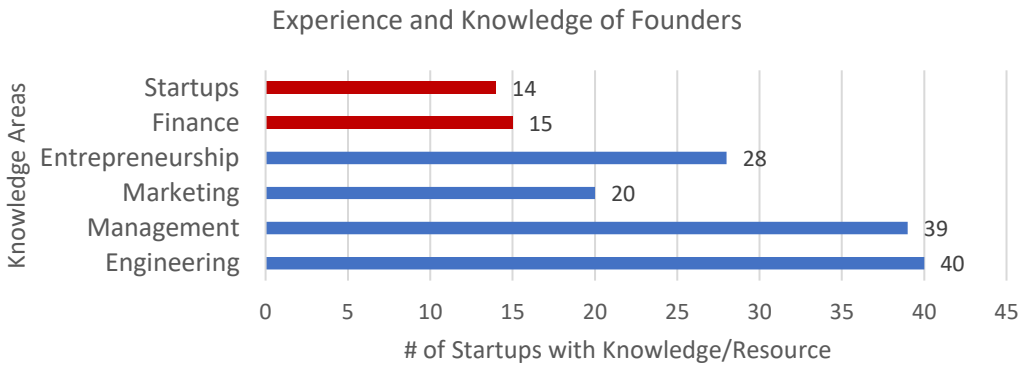

Figure 11: Experience and knowledge of founders, n=48.

Furthermore, only 14 of the 48 had strong connections in business development, with 20 of them having limited to no connections at all. Hence, hardware startups rarely have the knowledge or connections necessary to start a successful business. Thus, the Accompagnement Program should continue to provide these needs. Currently, the partnership with 1KUBATOR provides workshops on business development, while also connecting startups to customers and professionals. However, these business development services are offered *prix fixe* (reference Glossary) and are not targeted towards the unique challenges of hardware startups. We recommend that the program continue to provide these services, but to organize them under a single name and specialize the workshops for hardware.

6.1.4 Software Development Support - 1KUBATOR Partnership

Our survey results indicate that 70% of the 48 respondents integrated software or a mobile application into their hardware product, confirming the importance of software development for hardware startups (reference Appendix F.9). The 1KUBATOR partnership provides software, application, and website development to the Accompagnement Program participants. 1KUBATOR provides software and application development *prix fixe* in connection with its business development services. Again, the software development services are not targeted for hardware, but in this case, the two participants we interviewed did not feel that this was a problem. They also felt the price was fair and liked the short development time. We recommend that the software development services are kept in the program.

6.2 Reconfiguration of the Accompagnement Program

As the Accompagnement Program begins its partnership with Kickmaker, it is important to keep aspects of the current program (as mentioned in Section 5.1). However, it is paramount for the program to offer new services and re-structure the program in order to ensure its future success in meeting the needs of hardware startups. In the subsections below, we have made five recommendations to the future management of the Accompagnement program: provide a

fundraising program, price the program *à la carte*, specialize for a specific audience, strengthen the program's online presence, and increase connections with the ecosystem.

6.2.1 Help Provide Funding for Hardware Startups

Through our interviews and surveys with hardware startups, we learned that funding is one of the greatest challenges they face. According to our survey, acquiring funding was the most common challenge, selected by 38% of the respondents (reference Section 4.6). Furthermore, funding can be an obstacle to joining programs, and many startups cannot or do not wish to spend their funds or equity on resource programs. Our survey results revealed that most hardware startups who are interested in a program would prefer to pay for it with funding acquired through said program (reference Section 4.6), which is only possible if it includes a fundraising service. Hence, we recommend that the Accompagnement Program focus on acquiring funding for its participants. This will make the program more attractive to hardware startups because it addresses a major difficulty for them. Similarly, if the hardware startups in the program are well funded, they will be more willing to pay for the other services that the program provides.

To provide said funding, the Accompagnement Program should partner with resources such as the Banque Publique d'Investissement (BPI). A few hardware startups we interviewed received funding from this large French bank in their early stages of development. However, BPI is less likely to providing funding for startups which are closer to industrialization (reference Appendix B). Hence, we also recommend that the program work to cultivate partnerships with venture capitalists (VC's) to secure later funding for the hardware startups. Kickmaker already partners with The Hardware Club, a French hardware VC firm, which could prove to be a very valuable partnership to fulfill this recommendation.

6.2.2 *À La Carte*: Individual Services over *Prix Fixe* Program

Our survey results showed that hardware startups do not want an all-inclusive, *prix fixe* program that offers all services for a standardized cost (reference Section 4.2). Rather, they would prefer an *à la carte* program which they can customize by selecting and paying for only the areas where they need assistance. As mentioned in Section 5.1.1, the Accompagnement Program already offers its product development stages *à la carte*. However, the business and software development services offered via 1KUBATOR are *prix fixe*. Therefore, we recommend also offering the business and software development services *à la carte*, breaking them down into individual services such as marketing, accounting, and app development. This structure allows hardware startups to pick and choose which services they need, without having to pay for those that they do not.

Our interviews also shed light on the importance of trust within the hardware startup ecosystem. Hardware startups preferred to use resources that they trusted and to continue working with those resources for further stages when possible (reference Appendix B). Thus, we recommend that the program organize its *à la carte* services under one name, which will provide a clear structure and breakdown of the services. This is supported by our discussions with hardware startup four, who suggested that different resources need to communicate amongst themselves to ensure the success of their clients (reference Appendix B). Therefore, offering all services under one roof will both conveniently streamline the use the services for participants and improve their overall quality. Furthermore, if all the services are offered under one organization, hardware startups will be more trusting and therefore likely to remain with the program and use more services, which could increase the program's revenue.

6.2.3 Specialize Services for a Specific Audience

As described in Section 4.1, each startup's needs are quite different. However, there are indicators that can predict their interest in services, such as their level of experience and knowledge of hardware. Startups with less experience and knowledge need many broad, cost-effective services, whereas those with more experience and knowledge need fewer, higher quality services (reference Section 4.3). Thus, we recommend that the Accompagnement Program specialize its services for a specific audience. If the future management would prefer to target more experience startups, then we advise offering high-quality services in very specific areas. Since Kickmaker is already an expert at industrialization and is developing its KAL program in Lyon, they could consider optimizing mini série and design-for-industrialization services to target more experienced startups. Alternatively, if the future management would prefer to target less experienced hardware startups, we would recommend providing a wider range of more cost-effective services.

6.2.4 Strengthen and Target Online Presence

In our survey, we asked hardware startups how they heard about resource centers. 22% all the respondents found resources via the internet (reference Appendix F.6). When analyzing just responses from startups that were founded less than a year ago, this figure increased to 30%, as shown in Figure 12. Younger startups are more likely to rely on internet research since they do not have a lot of experience or connections yet.

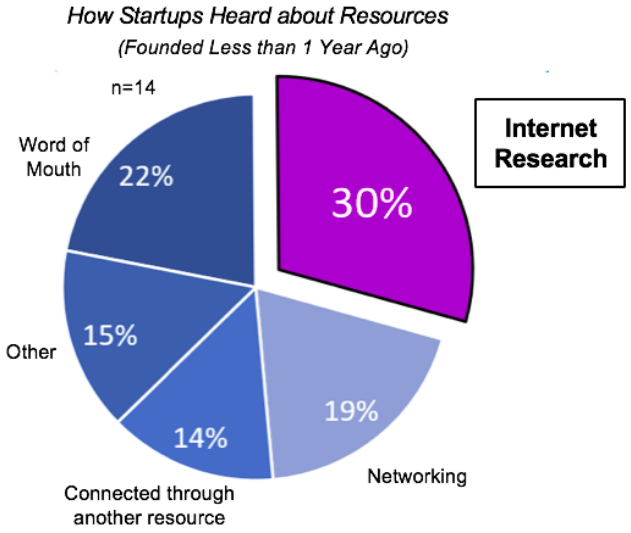

Figure 12: Early-stage hardware startups use internet searches more than other ways to find resource centers.

While networking and word-of-mouth collectively represent a larger section of the total population, the Accompagnement Program already does reach out to the ecosystem through these channels (34% of the respondents outside of Bel Air Camp had heard of the Accompagnement Program- reference Appendix F.7).

Currently, Bel Air Camp's website has only a small section about the Accompagnement Program, located on its page about the Tech Park. The section gives only a very broad overview of the program's features and a brief mention of its connection to 1KUBATOR (Le Tech Park).

Figure 13: Information about the Accompagnement Program from Bel Air Camp's website. None of the 'learn more' buttons direct to further information; they link to the general contact form. Retrieved June 19, 2019, from https://www.belaircamp.org/tech-park/

Given that we were not able to find much useful information about the program from the website, we can extrapolate that a startup which does not already know about the program would have even more difficulty in learning about the program. Therefore, we recommend that the Accompagnement Program increase its online presence. Adding more details and making the Accompagnement Program more visible on the site structure would tap into a new sector of hardware startups that primarily use the internet to find its resources. If the program wanted to target early-stage startups, it would need to increase its presence online to reach the 30% of young hardware startups that use the internet.

Since hardware startups are hesitant to commit their funds to a program if they think they can accomplish the same task on their own, the internet description of the Accompagnement Program should emphasize that it offers much more to its participants than simply the ability to complete the product development stages. The description should include not only details about its structure, but also a focus on its intangible benefits, such as its connections with the ecosystem.

6.2.5 Be Present and Well Connected to the Hardware Startup Ecosystem

Since hardware startups value their reputation and connections, it is important for the resource centers to be well connected within the hardware startup ecosystem. Many of the hardware startups in our survey realized in hindsight that they should have used more services; most of these startups did not realize that resource centers offered the services they wanted. Services which many startups would have wanted, but did not know about, include making connections to manufacturers (75%), making connections with customers (45%), assistance with intellectual property (40%) and programs with all services (37%) (reference Appendix F.5). These services are in demand, so the Accompagnement Program should provide and market them. Making connections can serve both to provide these services, for instance providing technical expertise through partnerships with engineering consultants, and to make their availability more well-known to startups who look for resources through connections and word of mouth. Figure 16 below also reaffirms our claim that hardware startups value connections, since making connections was a primary reason for using ecosystem resources. The Accompagnement Program can become more embedded in the ecosystem by increasing its connections, facilitating the success of both the program and its participants.

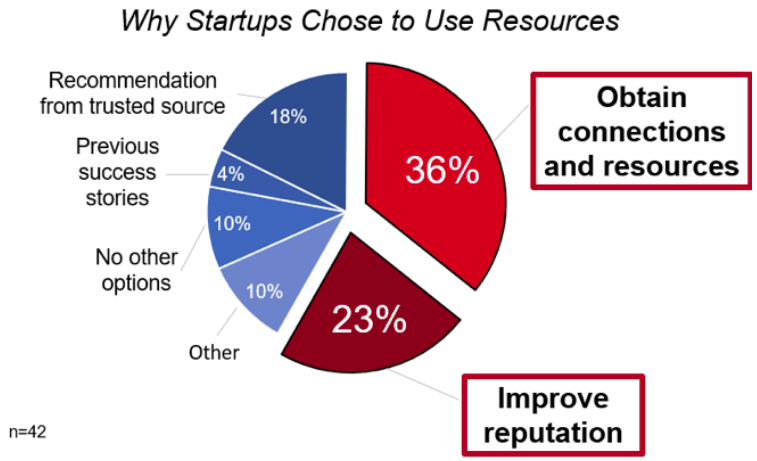

Figure 14: Hardware startups utilize resource to obtain better connections and improve their reputation.

Kickmaker, an industrialization consultant, is expected to take part in the management of the Accompagnement Program at Bel Air Camp; its expertise and connections in large-scale manufacturing, which it has demonstrated in Paris, can be extended into Lyon. The case study of HAX demonstrates how a resource center can connect to the hardware startup ecosystem in two different locations; HAX's success comes from bridging connections between China and San Francisco (reference Appendix G). The Kickmaker partnership will help Bel Air's Accompagnement Program in countless ways, complementing Bel Air's capabilities in prototyping and connections in Lyon with Kickmaker's expertise in large-scale manufacturing and links to Paris. The partnership will help take hardware startups from POC (Proof of Concept) to large-scale manufacturing through the Accompagnement Program.

7.0 Conclusion

While the Accompagnement Program already meets some needs of hardware startups in the Rhône-Alpes region, an adjustment to its services and structure will do this more effectively as it comes under new management from Kickmaker. To formulate this conclusion, we first interviewed eleven hardware startups and four resource centers. After this initial collection of qualitative data, we formulated a survey to reach a larger audience of hardware startups and collect some quantitative data. Through the analysis of these survey results, we learned that every hardware startup is quite unique, hence has unique needs and challenges. However, there were some patterns between hardware startups. One trend is the level of experience of each startup impacts the type of resources they want. Hardware startups are also generally not interested in a *prix fixe* program, since they do not want to pay for assistance in places where they already have experience or knowledge. Furthermore, hardware startups choose to join resources because they value their reputation and connections. Lastly, hardware startups have the greatest trouble with acquiring funding.

Our comparison of these findings with the services of the Accompagnement Program suggests strengths of the current program and opportunities for future developments. Some strengths of the existing program are its individual product development stages and current networking ability. Likewise, the opportunities for the future of the Accompagnement Program include offering services *à la carte* and including fundraising as its primary service. The program could also specialize for a specific demographic of hardware startups, increase its online presence, and continue making important connections in the ecosystem. By incorporating services and structures that address the most critical challenges of hardware startups, the Accompagnement Program will be better aligned with the hardware startup ecosystem and contribute towards the success of the program's future participants.

As the Accompagnement Program undergoes a metamorphosis for the new partnership between Kickmaker and Bel Air Camp, our recommendations have the potential to be fully integrated into the program, if the management chooses to do so. However, our recommendations are not quick fixes. For instance, providing funding requires resources that may be difficult to obtain from traditional financial institutions which might be wary of hardware startups. Developing and managing an *à la carte* program requires experienced personnel in different areas to meet the unique needs of each hardware startup. Nonetheless, we are optimistic that the future partnership with Kickmaker will provide access to the resources necessary to carry out such a program. Kickmaker already has an assembly line (KAL) in Paris to help hardware startups through the manufacturing stage in the product development process. Kickmaker-Bel Air Camp partnership will also include smaller actors, such as engineering consultants and free-lancers. This collaboration of resources and expertise will enable the next version of the Accompagnement Program to consider our recommendations fully and facilitate the future success of hardware startups.

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Appendix A

Begin all interviews with: We will be using this information to develop a report for our school in conjunction with the Tech Park at Bel Air Camp. This information will be used confidentially. If we were to want to quote you, written consent via email will be requested. You can leave the interview at any time.

A.1 Interview Questions for Hardware Startups

All startups:

1. What product does your company make and what problem does it address or 'fix'?
2. What is your company's story or timeline? Specifically, when did these milestones first occur? (Idea formulation, confidence in long-term success, funding, utilization of a service you had to pay for, POC, prototyping, customer feedback, Design for Manufacturing)
3. What stage in the development of your startup are you in now?

If in early stages: (little to no funding, no finalized prototype, little customer interaction)

4. What is your next step for the company?
5. How are you going about acquiring funding, the resources and knowledge to make a prototype, and connect with customers?
6. What has been your greatest challenge as a hardware startup?
7. What would be the most helpful resource for your hardware startup?
8. Have you thought of using resource centers like an incubator, accelerator, or makerspace to 'solve' question 4 or 5?
9. Do you know of Bel Air Camp's Tech Park in Villeurbanne?
    a. If yes, what do you think it does? What has prevented you from reaching out?

If in middle stages: (some funding, completed prototype, understands the position in their market)

10. How do you plan to industrialize your prototype? Have you gotten assistance with design for manufacturing or connecting with manufacturers?
11. How did you go about acquiring funding, the resources and knowledge to make a prototype, and connect with customers?
12. What been your greatest challenge as a hardware startup?
13. What would be the most helpful resource for your hardware startup?
14. Did you use resource centers like an incubator, accelerator, or makerspace to 'solve' question 4 or 5?
15. Do you know of Bel Air Camp's Tech Park in Villeurbanne?
    a. If yes, what do you think it does? What has prevented you from reaching out?

If in later stages: (stable funding platform, the product is being manufactured, the possible first round of sales, has eyes on a profit/revenue)

16. How did you industrialize your prototype and get connected with manufacturers?

17. How did you go about acquiring funding, the resources and knowledge to make a prototype, and connect with customers?
18. What been your greatest challenge as a hardware startup?
19. What would be the most helpful resource for your hardware startup?
20. Did you use resource centers like an incubator, accelerator, or makerspace to 'solve' question 4 or 5?
21. Do you know of Bel Air Camp's Tech Park in Villeurbanne?
    a. If yes, what do you think it does? What has prevented you from reaching out?

A.2 Additional Questions for Bel Air Camp Startups

1. Do or did you use the Tech Park?
    a. Yes: What are your thoughts on it?
    b. No: Why not?
2. Have you heard of the Accompagnement Program or 1KFABRIK?
3. What are your thoughts on the program? How would you make it better?

A.3 Additional Questions for Startups Using Accompagnement Program

1. How did you hear about the Accompagnement Program?
2. Why did you decide to use the program?
3. Describe the process of the program?
4. What was the most useful and why?
5. What was the least useful and why?
6. Did you start the program and then decide not to finish it?
    a. If yes, why?
7. What would you change about the program and why?

Appendix B: Hardware Startup Interview Data

Hardware Startup	***At Bel Air?***	***Previous Skills/ Connections***	***Prototyping/ Design***	***Manufacturing***
One	yes	no	Used a Product Development Resource	Hasn't happened yet
Eight	yes	no	Working within company	Currently fixing problems with manufacturers
Seven	yes	service industry	Contracted engineers to make iterative designs	Using intermediary to find manufacturers in China
Six	yes	management experience; business connections in France and China	Hired university lab to create design	Sent specifications to manufacturer in China, fixing small issues
Two	yes	connection with a local incubator	Developed partnerships to create designs, using internet resources for prototyping, worked with 1KUBATOR/1KFABRIK at one point	working with French Industrial
Ten	yes	software	Used online resources, external partner helping with hardware, conducting market testing	Ongoing, difficulties finding good manufacturers
Three	yes	engineering	Making prototypes themselves, partnership to source some components	Not a lot of background in mass manufacturing
Five	no	software, business, and marketing	Made first prototype on their own, then used Minalogic to do further hardware prototyping and outsource components,	Limited beta test distribution now happening within Lyon

			company focuses on the software	
Four	yes	engineering, some business	Made first design with engineers, then went to Pulsalys accelerator	Using subcontractors to manufacture in France, selling 5th version of design
Nine	no	engineering, and connections with other people who have an array of skills	Utilized services of a resource center	Has not thought of it yet, but does not want to use a program, rather would make connections

Hardware Startup	***Fundraising***	***Other Resources***	***Biggest Challenges***
One	Through Resource	a local incubator	money and access to machinery
Eight	3 rounds, happened before first prototype	Co-working space	problems with manufacturing
Seven	investors		not spending enough time on prototyping; access to funding hindered creativity
Six	Funding from lab and parent company	La French Tech, French Fab, many connections	problems with manufacturing
Two	BPI France, investment by company members, looking for more investors	Axandus, Altyor, SNSM, etc.	acquiring funding, prototype-to-manufacturing, finding manufacturers
Ten	Crowdfunding	incubator, La French Tech	lack of hardware experience, issues with manufacturers, difficulty of modifying hardware
Three	Research funding and partnership	external partnerships	not being in an incubator, didn't do enough marketing research, lack of business and manufacturing experience, funding
Five	Captronic, selling beta tests	2 incubators (BoostInLyon, H7), Bureau d'Etudes	funding (especially in early stages), rapid pace

Four	Kickstarter, ecological government department, Pulsalys/BPI	Reseau Entreprendre, INSA	legal work with patenting
Nine	through government and in the future the use of POC from companies and investors	incubator, malt.com	working alone has been an issue

Table 5: Hardware startup interview responses to commonly answered questions.

Hardware Startup	***Key Takeaways***
One	- Needs more money, problems with financing - Did not know about the program but rather approached - which might be an issue trying to attract people since that requires a lot of resources - a bit early to Bel Air Camp so got into 1KFABRIK program and started with the ideation phase - At 1KUBATOR: workshops (destress). Liked everything about it, mainly the ideation step as they evaluated his idea to see the value in it - Important to think about mass production while prototyping - Iterative process here to create prototypes - Money a big thing while being young- do not have a lot to live off of is what he thought was important - Manager of Tech Park helped teach skills such as 3D printing
Eight	- Got funding with just the idea, no prototype - Tools and materials developed by these young engineering interns. - Co-working offices in Lyon were used. First couple of prototypes built there. - In 3rd round of funding right now, - Passion is key. - Foolish optimism and naivety. - People Underestimate getting from prototyping from manufacturing. It is complicated. - Time to market: quality issues, team training. Issue is product is complex, needs to be fully autonomous.
Seven	- Learning from mistakes (iterating) is very important in hardware - Wouldn't like step-by-step process that does everything, only wanted help with certain parts - Very difficult to industrialize connections - Most useful resource: Intermediary - Didn't use a program like we mentioned because it was too expensive (even though there was money!)

	- Used his connections to get engineering/design/manufacturing help as opposed to services or companies - Didn't design for manufacturing and that hurt them in the long run - Service industries and tech industries need completely different approaches - Important to fix the small problems before you start mass production - otherwise the problems multiply - Even if individual parts are perfect, interactions can still cause problems - Having clients pushes you to rush - Lots of the manufacturing of parts had to be outsourced, took time so having local manufacturers is better
Six	- Connections are super important - You need legitimacy to get good funding - Working with china is hard - need to have a very exact process for doing so - He really valued structure and outlines of the way things would be designed. Tech park doesn't currently do that - Tech park wasn't appealing to them - it didn't have the legitimacy, no connection/trust network, didn't have quality engineering or technical knowledge to work with sensors
Two	- Mass production the main problem - DEATH VALLEY - Prototyping not really an issue - Paid more for resource that did everything for them - BENEFIT OR VALUE HIGHER THAN COST so worth it for Ido-Data - Backing of a big and well-known company helps get funding
Ten	- Hardware is tough as you cannot go back and just undo things like you can in software - Decisions need to be made carefully - Has partner outside Bel Air Camp that helps with electronic side of product - A mentor from La French Tech networking event that advices on decision making - Still in contact with her (the mentor) - In the manufacturing phase - Used AliBaba initially to get manufacturing help from China
Three	- Didn't do any market research and isn't able to sell these kits - Has no knowledge of manufacturing and is not able to scale up production - Had a need for an incubator-style program that would assist them in taking their technology to market - As an engineering company - had the technology and knowledge to make and prototype their design

	- needed assistance in business, manufacturing, and connections - would like to use Kickmaker/Accompagnement program if he could - Bel Air is very useful in providing them the community/connections needed but doesn't provide the necessary business development help - Engineers are afraid/unmotivated to come to tech park to 'learn' the machines here - 1KUBATOR: Had business development he needed, didn't like payment structure or lack of space - Was willing to pay for someone that knew how to do the business or manufacturing!!! - The Accompagnement Program needs to include some sort of funding structure - The Accompagnement Program needs to help with manufacturing! Either DFM or scale up
Five	- BoostInLyon had a personalized Accompagnement Program for each startup - Important as each startup has different need and is at a different stage of the process (Something to think about for Bel Air's Accompagnement Program) - BPI France helps (financial center for startups at the beginning) - Do not have a lot of funding at the first phase now - Not a lot of funding available for startups in very early stages - Can't get much with only an idea - Did not want to use a resource that required giving up equity in the company - Most incubators in Lyon do take equity (including 1KUBTAOR) - Learned a lot from initial failures in making the first prototype - definitely valued the resources used later, but would not have wanted to use a resource at the very beginning - The area of specialty was in software, so he was not interested in developing hardware on his own or create his own prototypes - rather would have had another company do it
Four	- Business and product development partners should communicate with each other. - Should be well balanced and both share information and understand each other. This would help the product meet the needs of the market. - Business Development needs to happen simultaneously with product development - Build a good process, DON'T GO TOO FAST! - Tech Park needs to communicate a lot with 1KUBATOR - Get public help - IMPORTANT TO CONSIDER FOR SURVEY (FUNDING OPTIONS) - Do not take much equity - Public investment help (VC's and others) are more willing to help younger ideas nowadays

	- If you try on your own and really fail, can not really get help. Starting something and doing something yourself requires a lot of energy - Everyone in the network advices you go to someone for help (at least for business help) - Engineers know they need help on the business side, so will want to work with a network of advisors for this area. Might try to build prototype themselves if they have the resources - These support networks are advisors - Important to get customer feedback on prototypes to keep the iterative process going and improving your product - First step was to get in touch with engineers to design product (maybe trend that hardware likes to get designed before they find help) - Then used Pulsalys to get the manufacturing and engineering help needed - Startups need a lot of legal help - Accompagnement Program can't offer it
Nine	- Doesn't like 10% equity, it's too much!! - Once again, connections were key to why he got resource help - JA does have the connections needed for prototyping - A space like the Tech Park needs to be open 24/7 for budding entrepreneurs - Wants to hire specialist for industrialization - Wouldn't pay for a 'all inclusive' program - Would pay for a 'networking' program!

Table 6: Key takeaways from interviews with hardware startups.

Appendix C: Manager's Ratings of the Accompagnement Program

Ratings of the Accompagnement Program are on a scale of 0 to 5, with 0 being a very low capability and 5 being an excellent capability.

Prototype manufacturing connections	2.5
Large scale manufacturing connections	0.5
3D printing for prototyping	4
Metal machining	2
Electrical design/ embedded electronics/ sensors	1
Laser cutting	4
Injection or vacuum molding	0
Woodworking	2.5
Project management	4
Programming	0
Mechanical design	5

Table 7: Ratings of Accompagnement Program capabilities.

Appendix D: Survey Questions

Q1: Hello! We are a group of American students studying at Worcester Polytechnic Institute near Boston, Massachusetts. We are here performing a project to understand the hardware startup ecosystem in the Rhône-Alpes region and the rest of France. The survey responses will remain confidential. It will take less than 10 minutes!
Q2: What is the name of your startup company?
Q3: Does your startup offer any hardware or physical products?

- Yes: Some or all of my product is physical hardware (1)
- No: My product doesn't use any physical hardware (2)

Skip To: Q7 If Does your startup offer any hardware or physical products? = Yes: Some or all of my product is physical hardware
Skip To: Q4 If Does your startup offer any hardware or physical products? = No: My product doesn't use any physical hardware

Q4 Are you interested in developing hardware for your business?

- Not interested (1)
- Somewhat interested (2)
- Very interested (3)

Skip To: Q6 If Are you interested in developing hardware for your business? != Not interested

Q5 Which statement best describes your company's reason for not developing hardware?

- Hardware is not relevant to the company's goal (1)
- Relevant hardware is already produced by another company (2)
- Have no experience or resources for developing hardware (3)
- Other: (4) _____

Skip To: End of Survey If Which statement best describes your company's reason for not developing hardware? != Have no experience or resources for developing hardware

Q6 Would you be willing to pay for a program that would assist your startup in developing hardware?

- Yes, I would pay a moderate amount (1)
- Yes, I would pay a substantial amount (2)
- No, I would not want to pay (3)
- No, I have no interest in this program (4)

Skip To: End of Survey If Would you be willing to pay for a program that would assist your startup in developing hardware? = Yes, I would pay a moderate amount
Skip To: End of Survey If Would you be willing to pay for a program that would assist your startup in developing hardware? != Yes, I would pay a moderate amount

Q7: To what extent is each type of technology used in your product?

	Not at all (1)	Somewhat (2)	Very much (3)
Sensors (1)			
Software / App Development (3)			
Electronics (4)			
Plastic Forming / Molding / 3D Printing (6)			
IoT (7)			
Mechanics (8)			
Metalwork / Machining (9)			
Robotics (11)			
Other Hardware Technology: (13)			

Q8: When was your startup founded?

- Less than a year ago (1)
- Less than three years ago (2)
- More than three years ago (3)

Q9: Did the founding group have experience or education in one or more of the following areas? (Select all that apply)

- Engineering (1)
- Management (2)
- Marketing (3)
- Entrepreneurship (4)
- Experience in startups (8)
- Finance (5)
- None of the above (7)

Q10: When your startup first conceptualized the idea to develop your product, please rate the founding group's:

	Limited (2)	Moderate (3)	Strong (4)
Knowledge of the technology necessary to make your product (1)			

Connections with those in the industrial manufacturing industry (2)			
Connections with business development in the area (3)			

Q11: Which milestones have occurred (or are occurring) for your startup?

- Joined an incubator. (15)
- Joined an accelerator. (16)
- Joined a makerspace. (17)
- Received potential customer feedback on idea. (4)
- Proof of Concept (5)
- First gained funding. (6)
- Started prototyping (7)
- Created multiple prototypes (8)
- Produced limited run of product (9)
- Started manufacturing (11)
- Developed business plan. (13)
- Licensed business with government and gotten VAT number. (14)

Carry Forward Selected Choices from "Which milestones have occurred (or are occurring) for your startup?"

Q12: Please order the selected milestones in the order in which they occurred.
_____ Joined an incubator. (1)
_____ Joined an accelerator. (2)
_____ Joined a makerspace. (3)
_____ Received potential customer feedback on idea. (4)
_____ Proof of Concept (5)
_____ First gained funding. (6)
_____ Started prototyping (7)
_____ Created multiple prototypes (8)
_____ Produced limited run of product (9)
_____ Started manufacturing (10)
_____ Developed business plan. (11)
_____ Licensed business with government and gotten VAT number. (12)

Display This Question:

If Which milestones have occurred (or are occurring) for your startup? = Joined an incubator.

Or Which milestones have occurred (or are occurring) for your startup? = Joined an accelerator.

Or Which milestones have occurred (or are occurring) for your startup? = Joined a makerspace.

Q13: How did you hear about the incubators, makerspaces, or accelerators that you have used?

- Word of mouth (1)
- Internet research (2)
- Network or networking event (3)
- Connected through another resource (4)
- Other: (5) _____

Display This Question:

If Which milestones have occurred (or are occurring) for your startup? = Joined an incubator.

Or Which milestones have occurred (or are occurring) for your startup? = Joined an accelerator.

Or Which milestones have occurred (or are occurring) for your startup? = Joined a makerspace.

Q14 Why did you choose to use these resources?

- Unable to continue project without the service – had no other feasible options. (1)
- The service had numerous previous success stories. (2)
- The service was specifically recommended by a trusted source. (3)
- The service offered resources or connections that could not be attained on your own. (4)
- The service could improve the reputation of your startup (5)
- Other: (6) _____

Display This Question:

If Which milestones have occurred (or are occurring) for your startup? != Joined an incubator.

And Which milestones have occurred (or are occurring) for your startup? != Joined an accelerator.

And Which milestones have occurred (or are occurring) for your startup? != Joined a makerspace.

Q15 Which statements describe your company's reason for not using an incubator, makerspace, or accelerator?

- Already had knowledge (1)
- Too expensive (2)
- Too far away (3)
- Did not add value (4)
- Didn’t align with your needs (5)
- Other: (6) _____

Q16: What is the most challenging part(s) of the prototyping process for your startup?

- Acquiring funding. (1)
- Using prototyping processes and tools. (3)
- Learning about the technology needed in your product. (6)
- Adapting prototypes for manufacturing. (4)
- Finding manufacturers for your product. (7)
- Other: (5) _____

Q17: Have you used a program with these elements?

	Yes, have used, using, or plan to use a program with this element (1)	Yes, but I should not have used this program (8)	No, but I should have used a program with this element (5)	No, not interested in this element of a program (7)
Structured project methodology (1)				
Proof of concept (11)				
Prototyping (12)				
Development of the product for manufacturing (13)				
Connection to Manufacturers (14)				
Connection with Customers (15)				
Fundraising (16)				
Business Development (17)				
Marketing (18)				
Intellectual Property (19)				
A program with all of the stages (20)				

Display This Question:

If Have you used a program with these elements? = Yes, have used, using, or plan to use a program with this element

Carry Forward Selected Choices from "Have you used a program with these elements?"

Q18: How would you prefer to pay for these programs/elements? (Can select multiple payment options for each program/element)

	Pay for it after a free trial (1)	Pay for it in equity (2)	Pay for it with funding acquired through the program (4)	Pay for with outside funding (5)	Don't want to pay; will only use if it is free (6)	Other (7)
Structured project methodology (x1)						
Proof of concept (x11)						
Prototyping (x12)						
Development of the product for manufacturing (x13)						
Connection to Manufacturers (x14)						
Connection with Customers (x15)						
Fundraising (x16)						
Business Development (x17)						
Marketing (x18)						

Intellectual Property (x19)						
A program with all of the stages (x20)						

Display This Question:

If Have you used a program with these elements? [No, but I should have used a program with this element] (Count) > 0

Carry Forward Selected Choices from "Have you used a program with these elements?"

Q19: Why didn't you use these programs originally?

	The cost was outside of our price range (1)	The program was too expensive for the amount of value added (2)	Didn't know a program with that element existed (3)	Didn't think we needed assistance in that area at the time (4)	Other (5)
Structured project methodology (x1)					
Proof of concept (x11)					
Prototyping (x12)					
Development of the product for manufacturing (x13)					
Connection to Manufacturers (x14)					
Connection with Customers (x15)					
Fundraising (x16)					

Business Development (x17)					
Marketing (x18)					
Intellectual Property (x19)					
A program with all of the stages (x20)					

Display This Question:

If Have you used a program with these elements? [No, not interested in this element of a program] (Count) > 0

Carry Forward Selected Choices from "Have you used a program with these elements?"

Q20: Why are you uninterested in using these programs?

	There is no program in my price range (1)	Don't need assistance in this area (2)	Can get this assistance for free (3)	Not relevant to my startup (4)	Other (5)
Structured project methodology (x1)					
Proof of concept (x11)					
Prototyping (x12)					
Development of the product for manufacturing (x13)					
Connection to Manufacturers (x14)					
Connection with Customers (x15)					

Fundraising (x16)					
Business Development (x17)					
Marketing (x18)					
Intellectual Property (x19)					
A program with all of the stages (x20)					

Q21: Have you used any of the following resources?

	Yes, have used it (1)	No, have heard of it but never used it (3)	Have never heard of it (5)
1KUBATOR (1)			
1KFABRIK/Bel Air's Accompagnement Program (2)			
Axandus (9)			
Axeleo (7)			
Bel Air Camp (3)			
Bel Air's Tech Park (4)			
BoostInLyon (6)			
Imeca (10)			
Kickmaker (8)			

Q22 What other resources/services have you used to develop your company and your product?

_____

Display This Question:

If Have you used any of the following resources? = 1KFABRIK/Bel Air's Accompagnement Program [No, have heard of it but never used it]

Q23: What made you decide not to use 1KFABRIK/Bel Air's Accompagnement Program?

_____

Display This Question:

If Have you used any of the following resources? = 1KUBATOR [No, have heard of it but never used it]

Q24: What made you decide not to use 1KUBATOR?

_____

Display This Question:

If Have you used any of the following resources? = Kickmaker [No, have heard of it but never used it]

Q25: What made you decide not to use Kickmaker?

_____

Q26: If there is anything else you would like to tell us about resources/services for startups, please write it here.

_____

Appendix E: Follow-Up Survey Questionnaire

Hardware Startup Ecosystem Questionnaire - Already Interviewed

Hello! Thank you for allowing us to interview you. We ask you to please answer these few follow-up questions that we were not able to ask in the interview. The responses will remain confidential. It will take less than 10 minutes!

Q2 What is the name of your startup company?

_____

Q7: To what extent is each type of technology used in your product?

	Not at all (1)	Somewhat (2)	Very much (3)
Sensors (1)			
Software / App Development (3)			
Electronics (4)			
Plastic Forming / Molding / 3D Printing (6)			
IoT (7)			
Mechanics (8)			
Metalwork / Machining (9)			
Robotics (11)			
Other Hardware Technology: (13)			

Q9: Did the founding group have experience or education in one or more of the following areas? (Select all that apply)

- Engineering (1)
- Management (2)
- Marketing (3)
- Entrepreneurship (4)
- Experience in startups (8)
- Finance (5)
- None of the above (7)

Q10: When your startup first conceptualized the idea to develop your product, please rate the founding group's:

	Limited (2)	Moderate (3)	Strong (4)
Knowledge of the technology necessary to make your product (1)			
Connections with those in the industrial manufacturing industry (2)			
Connections with business development in the area (3)			

Q11:
Which milestones have occurred (or are occurring) for your startup?

- Joined an incubator. (15)
- Joined an accelerator. (16)
- Joined a makerspace. (17)
- Received potential customer feedback on idea. (4)
- Proof of Concept (5)
- First gained funding. (6)
- Started prototyping (7)
- Created multiple prototypes (8)
- Produced limited run of product (9)
- Started manufacturing (11)
- Developed business plan. (13)
- Licensed business with government and gotten VAT number. (14)

Carry Forward Selected Choices from "Which milestones have occurred (or are occurring) for your startup?"

Q12: Please order the selected milestones in the order in which they occurred.
_____ Joined an incubator. (1)
_____ Joined an accelerator. (2)
_____ Joined a makerspace. (3)
_____ Received potential customer feedback on idea. (4)
_____ Proof of Concept (5)
_____ First gained funding. (6)
_____ Started prototyping (7)
_____ Created multiple prototypes (8)
_____ Produced limited run of product (9)
_____ Started manufacturing (10)
_____ Developed business plan. (11)

_____ Licensed business with government and gotten VAT number. (12)

Display This Question:

If Which milestones have occurred (or are occurring) for your startup? = Joined an incubator.

Or Which milestones have occurred (or are occurring) for your startup? = Joined an accelerator.

Or Which milestones have occurred (or are occurring) for your startup? = Joined a makerspace.

Q13: How did you hear about the incubators, makerspaces, or accelerators that you have used?

- Word of mouth (1)
- Internet research (2)
- Network or networking event (3)
- Connected through another resource (4)
- Other: (5) _____

Display This Question:

If Which milestones have occurred (or are occurring) for your startup? = Joined an incubator.

Or Which milestones have occurred (or are occurring) for your startup? = Joined an accelerator.

Or Which milestones have occurred (or are occurring) for your startup? = Joined a makerspace.

Q14 Why did you choose to use these resources?

- Unable to continue project without the service – had no other feasible options. (1)
- The service had numerous previous success stories. (2)
- The service was specifically recommended by a trusted source. (3)
- The service offered resources or connections that could not be attained on your own. (4)
- The service could improve the reputation of your startup (5)
- Other: (6) _____

Display This Question:

If Which milestones have occurred (or are occurring) for your startup? != Joined an incubator.

And Which milestones have occurred (or are occurring) for your startup? != Joined an accelerator.

And Which milestones have occurred (or are occurring) for your startup? != Joined a makerspace.

Q15 Which statements describe your company's reason for not using an incubator, makerspace, or accelerator?

- Already had knowledge (1)
- Too expensive (2)
- Too far away (3)
- Did not add value (4)
- Didn't align with your needs (5)
- Other: (6) _____

Q16: What is the most challenging part(s) of the prototyping process for your startup?

- Acquiring funding. (1)
- Using prototyping processes and tools. (3)
- Learning about the technology needed in your product. (6)
- Adapting prototypes for manufacturing. (4)
- Finding manufacturers for your product. (7)
- Other: (5) _____

Q17: Have you used a program with these elements?

	Yes, have used, using, or plan to use a program with this element (1)	Yes, but I should not have used this program (8)	No, but I should have used a program with this element (5)	No, not interested in this element of a program (7)
Structured project methodology (1)				
Proof of concept (11)				
Prototyping (12)				
Development of the product for manufacturing (13)				
Connection to Manufacturers (14)				
Connection with Customers (15)				
Fundraising (16)				
Business Development (17)				
Marketing (18)				

Intellectual Property (19)				
A program with all of the stages (20)				

Display This Question:

If Have you used a program with these elements? = Yes, have used, using, or plan to use a program with this element

Carry Forward Selected Choices from "Have you used a program with these elements?"

Q18: How would you prefer to pay for these programs/elements? (Can select multiple payment options for each program/element)

	Pay for it after a free trial (1)	Pay for it in equity (2)	Pay for it with funding acquired through the program (4)	Pay for with outside funding (5)	Don't want to pay; will only use if it is free (6)	Other (7)
Structured project methodology (x1)						
Proof of concept (x11)						
Prototyping (x12)						
Development of the product for manufacturing (x13)						
Connection to Manufacturers (x14)						
Connection with Customers (x15)						
Fundraising (x16)						

Business Development (x17)						
Marketing (x18)						
Intellectual Property (x19)						
A program with all of the stages (x20)						

Display This Question:

If Have you used a program with these elements? [No, but I should have used a program with this element] (Count) > 0

Carry Forward Selected Choices from "Have you used a program with these elements?"

Q19: Why didn't you use these programs originally?

	The cost was outside of our price range (1)	The program was too expensive for the amount of value added (2)	Didn't know a program with that element existed (3)	Didn't think we needed assistance in that area at the time (4)	Other (5)
Structured project methodology (x1)					
Proof of concept (x11)					
Prototyping (x12)					
Development of the product for manufacturing (x13)					
Connection to Manufacturers (x14)					
Connection with					

Customers (x15)					
Fundraising (x16)					
Business Development (x17)					
Marketing (x18)					
Intellectual Property (x19)					
A program with all of the stages (x20)					

Display This Question:

If Have you used a program with these elements? [No, not interested in this element of a program] (Count) > 0

Carry Forward Selected Choices from "Have you used a program with these elements?"

Q20: Why are you uninterested in using these programs?

	There is no program in my price range (1)	Don’t need assistance in this area (2)	Can get this assistance for free (3)	Not relevant to my startup (4)	Other (5)
Structured project methodology (x1)					
Proof of concept (x11)					
Prototyping (x12)					
Development of the product for manufacturing (x13)					
Connection to Manufacturers (x14)					

Connection with Customers (x15)					
Fundraising (x16)					
Business Development (x17)					
Marketing (x18)					
Intellectual Property (x19)					
A program with all of the stages (x20)					

Q21: Have you used any of the following resources?

	Yes, have used it (1)	No, have heard of it but never used it (3)	Have never heard of it (5)
1KUBATOR (1)			
1KFABRIK/Bel Air's Accompagnement Program (2)			
Axandus (9)			
Axeleo (7)			
Bel Air Camp (3)			
Bel Air's Tech Park (4)			
BoostInLyon (6)			
Imeca (10)			
Kickmaker (8)			

Q22 What other resources/services have you used to develop your company and your product?

_____

Display This Question:

If Have you used any of the following resources? = 1KFABRIK/Bel Air's Accompagnement Program [No, have heard of it but never used it]

Q23: What made you decide not to use 1KFABRIK/Bel Air's Accompagnement Program?

_____

Display This Question:

If Have you used any of the following resources? = 1KUBATOR [No, have heard of it but never used it]

Q24: What made you decide not to use 1KUBATOR?

_____

Display This Question:

If Have you used any of the following resources? = Kickmaker [No, have heard of it but never used it]

Q25: What made you decide not to use Kickmaker?

_____

Q26: If there is anything else you would like to tell us about resources/services for startups, please write it here.

_____

Appendix F: Survey Results

F.1 Order of Milestones for Different Hardware Startups

Question 12 of the survey asked the respondents to order the milestones in the way they occurred for their hardware startup. Below are the detailed results.

	Incubator	Accelerator	Makerspace	Received Potential Customer Feedback	POC	First Gained Funding	Started Prototyping	Created Multiple Prototypes	Limited Run	Started Manu	Dev. Bus. Plan	VAT	
Frequency of First	6	1	0	2	9	3	7	1	0	0	5	7	
Frequency of Second	5	2	0	5	5	5	4	1	0	1	6	7	
Frequency of Third	4	1	1	9	5	4	4	4	3	0	1	5	
Frequency of Fourth	8	5	0	4	6	3	4	2	1	1	3	1	
Frequency of Fifth	3	0	4	3	1	5	5	3	0	2	2	6	
Frequency for Sixth	1	2	1	3	4	3	4	5	2	1	2	0	
Frequency for Seventh	1	2	2	3	3	5	1	3	1	0	3	1	
Frequency for Eighth	0	1	0	2	0	2	2	5	4	3	2	1	
Frequency for Ninth	1	0	1	0	1	0	0	5	4	5	0	0	
Frequency for Tenth	0	0	0	1	1	0	0	1	6	1	0	0	
Frequency for Eleventh	0	1	0	1	0	0	0	0	0	2	1	0	
Frequency for Twelfth	0	0	1	0	0	0	0	0	0	0	0	0	
Count of Each Milestone	29	15	10	33	35	30	31	30	21	16	25	28	48
Percent of Count/Total	60%	31%	21%	69%	73%	63%	65%	63%	44%	33%	52%	58%	
# of Respondents													

Figure 15: Question 12, Order of Milestones, n=48

F.2 Program Elements

Question 17 of the survey asked the startups whether they used programs which would help them with certain elements of product development. The question included ten elements, plus an option for all the elements combined into a single program. The four choices were 'Yes, have used, using, or plan to use', 'Yes, but I should not have used this', 'No, but I should have used this', or 'No, not interested'. Depending on which answer they chose for each element, Questions 18-20 asked a follow-up question about why they did not use such a program or how they would prefer to pay for it.

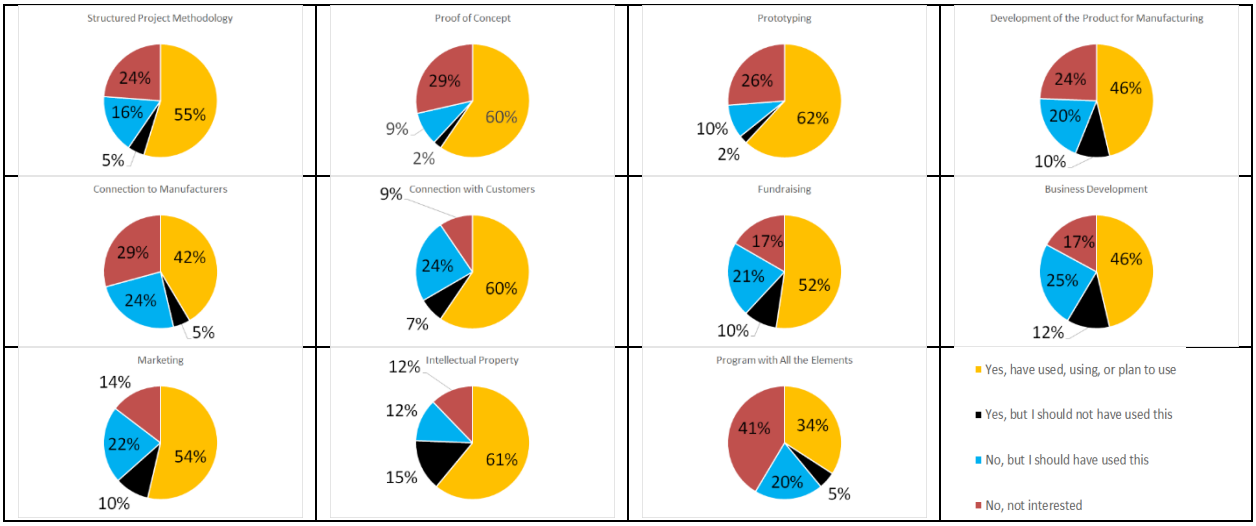


Figure 16: Question 17, usage of program elements, n=42.

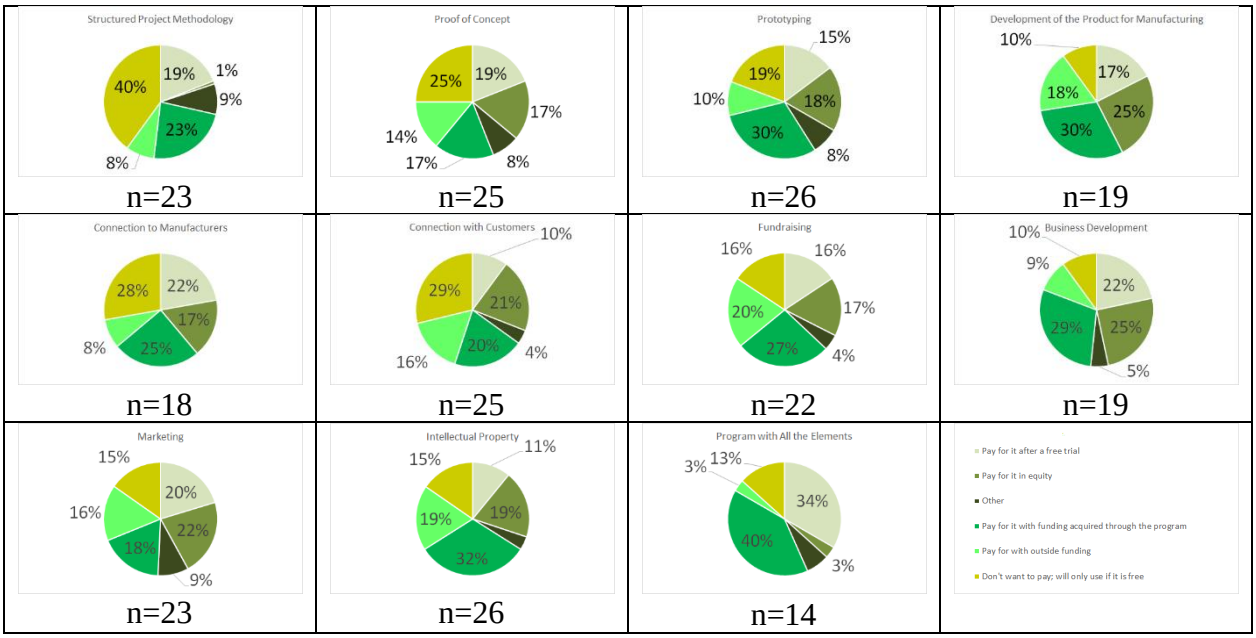


Figure 17: Question 18, how startups prefer to pay for programs they are interested in.

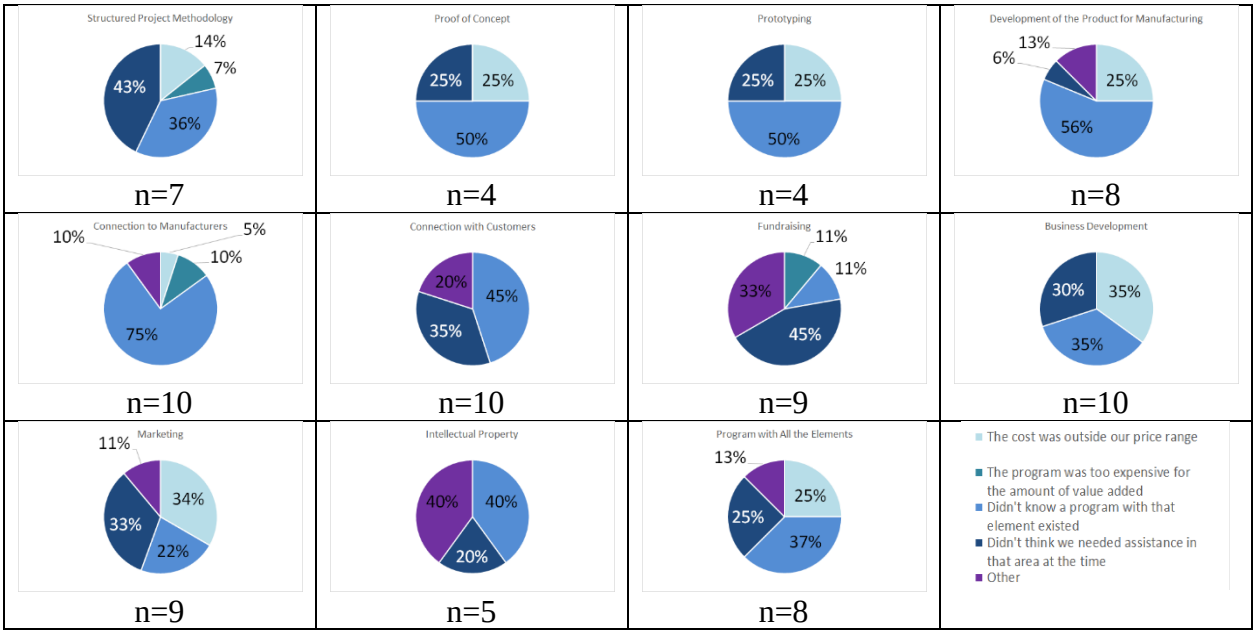
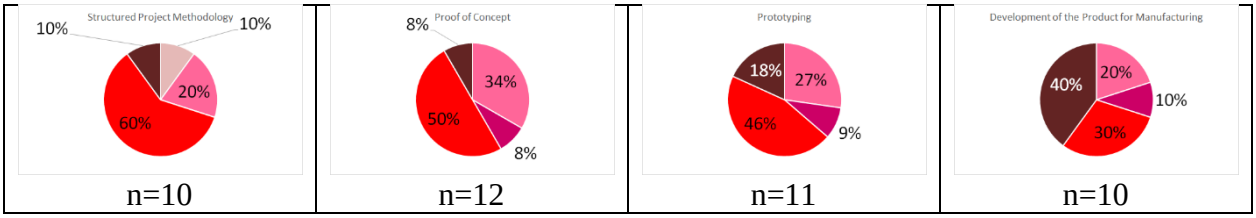


Figure 18: Question 19, why startups did not originally use programs which they now realize are valuable.



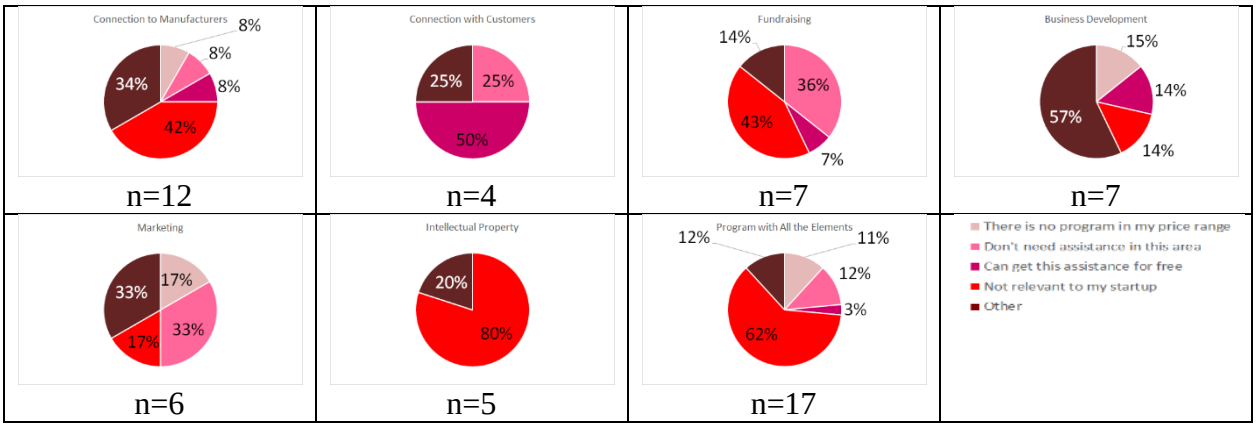


Figure 19: Question 20, why startups are uninterested in programs.

F.3 Greatest Challenges

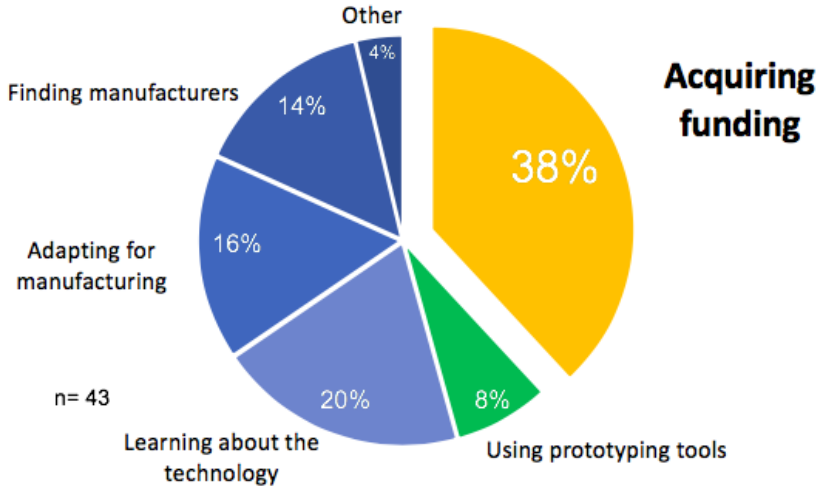
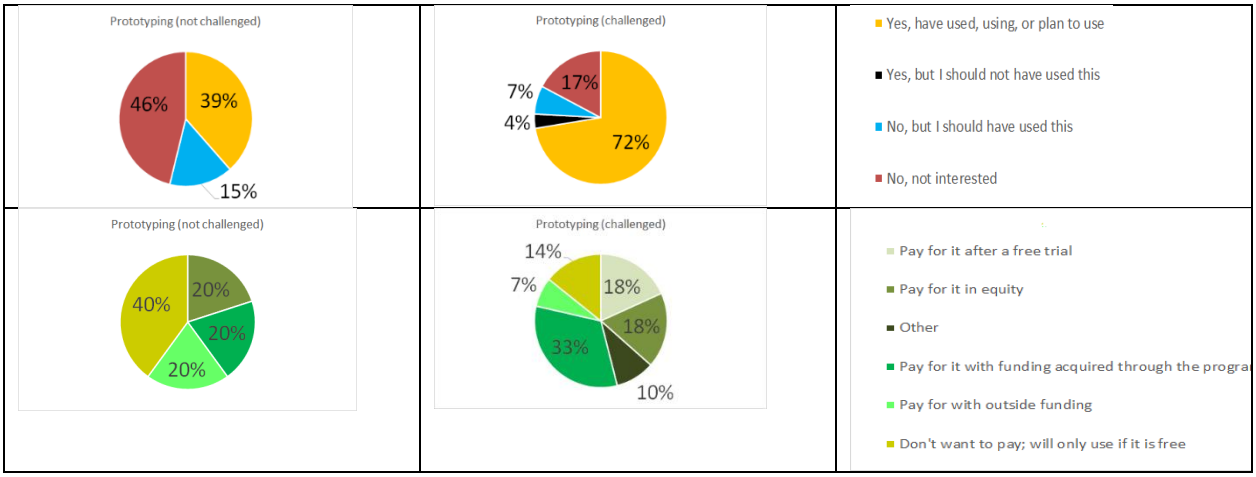


Figure 20: Greatest challenges of hardware startups, n=43.

F.4 Interest in Programs Compared to Prototyping Challenges



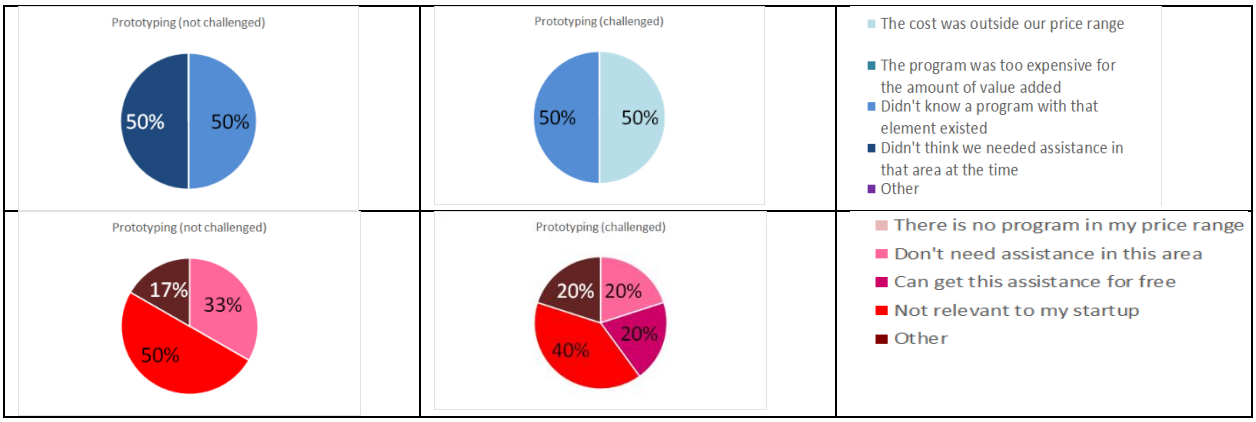


Figure 21: Comparison of companies who did not indicate 'learning about the technology used in your product', 'using prototyping tools and equipment', or 'adapting prototypes for manufacturing' as a challenge with those who did select these challenges. n=13 and n=29.

F.5 Interest Compared to Age of Startup

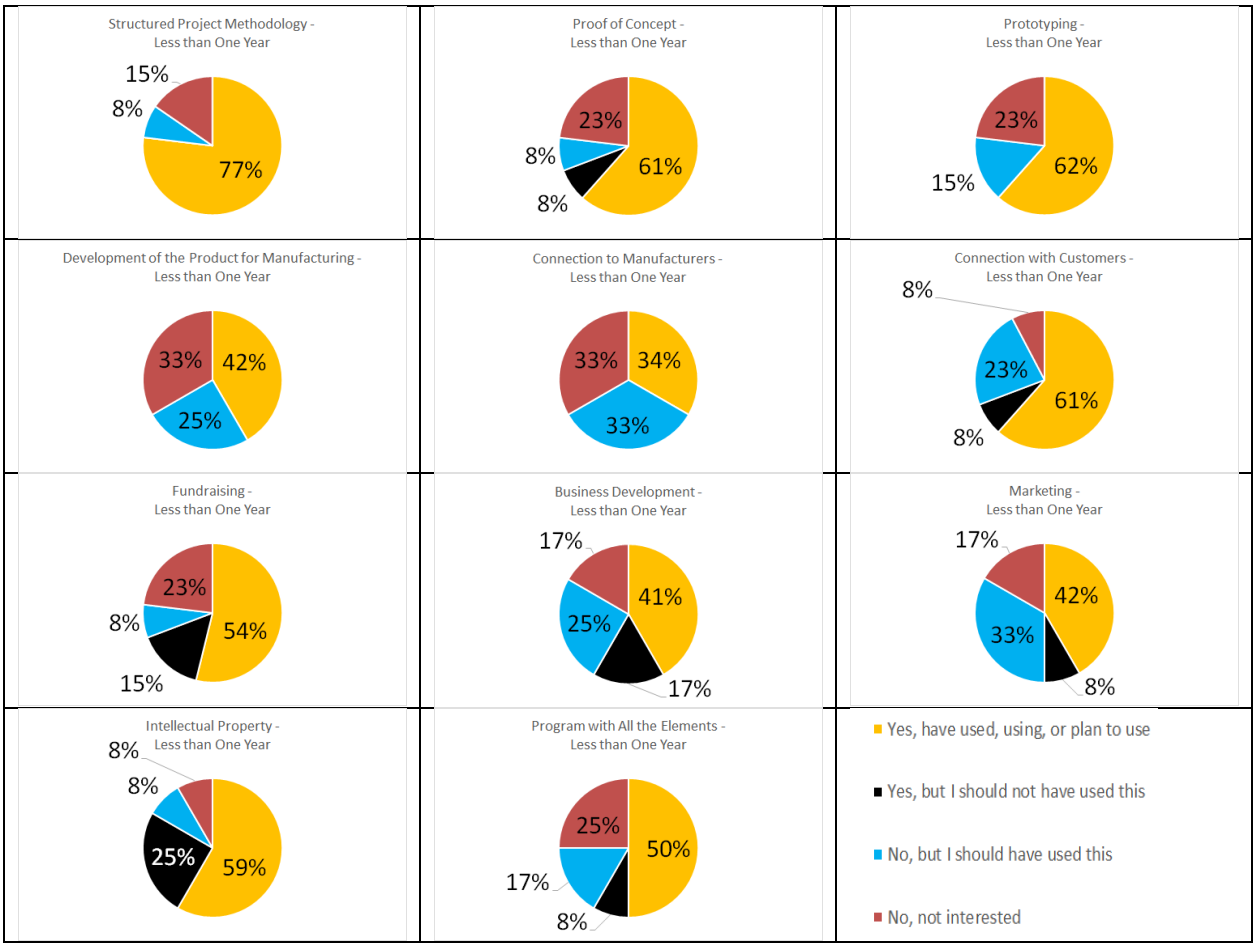
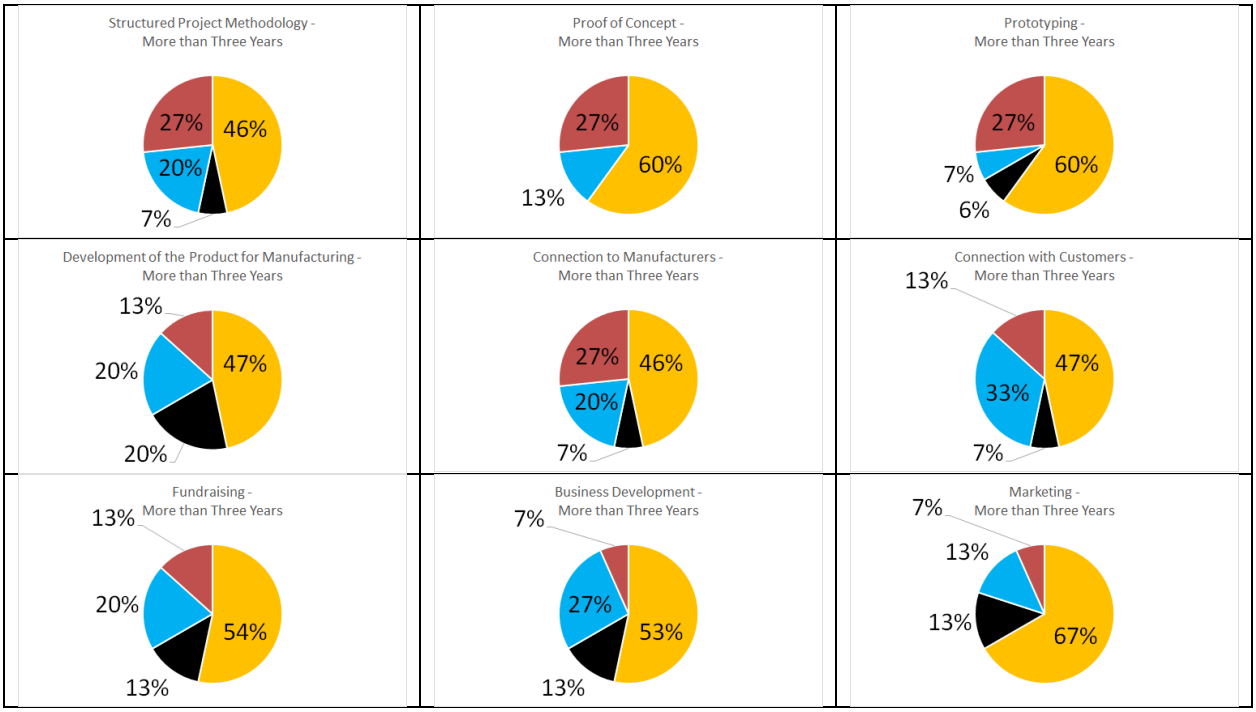


Figure 22: Interest in program elements for startups founded less than one year ago, n=14.

Figure 23: Interest in program elements for startups founded between one and three years ago, n=16.



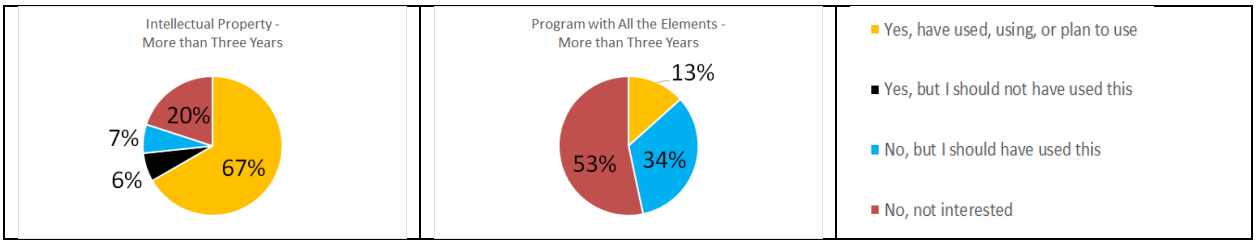


Figure 24: Interest in program elements for startups founded more than three years ago, n=17.

F.6 Usage of Incubators, Accelerators, and Makerspaces

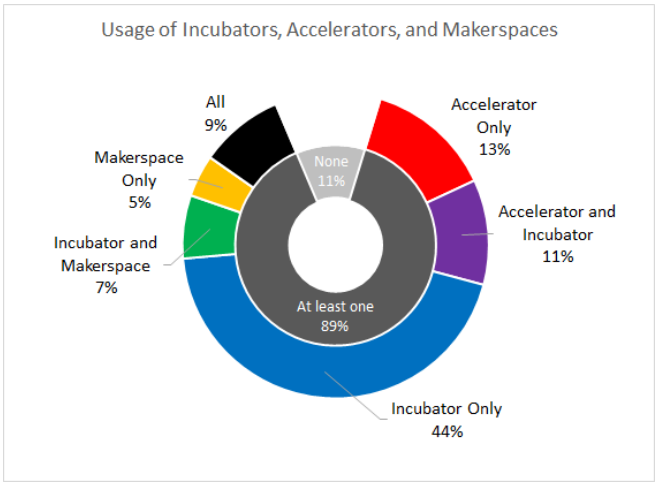


Figure 25: Usage of incubators, accelerators, and makerspaces, n=42.

Makerspaces, or open workshops of tools and machinery, were included in the survey because they are important resource for startups in the United States, and we thought that the same might be true in France. However, this seems not to be the case, as only 21% of the survey respondents used a makerspace, and makerspaces were rarely mentioned in the interviews. This may be partly because other resources provide workshops which fulfill the same need for tools and spaces.

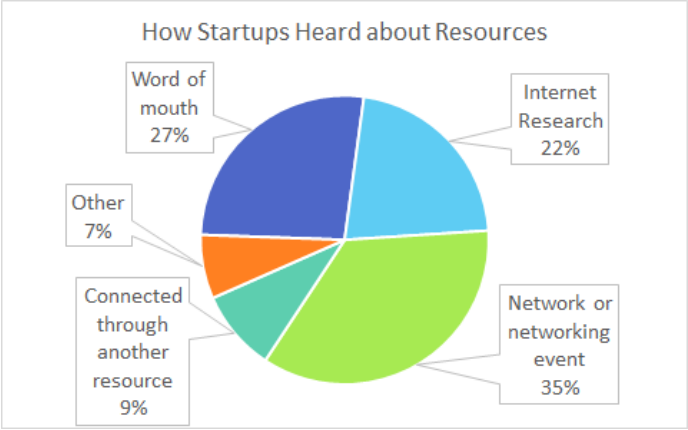


Figure 26: How startups heard about the resources they used, n=41.

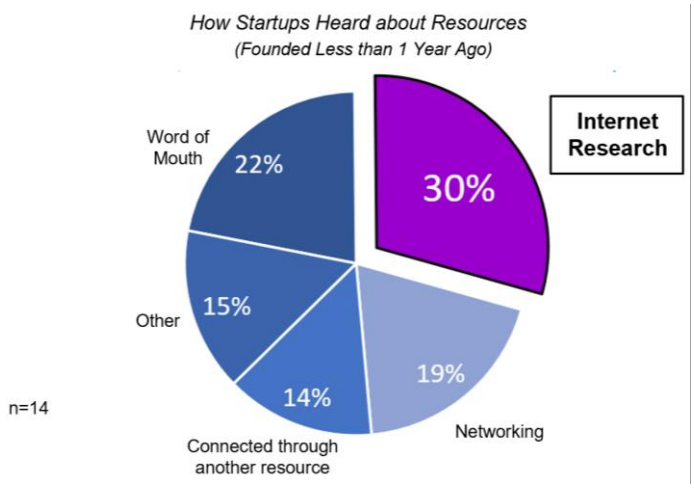


Figure 27: How startups founded less than a year ago heard about the resources they used, n=14.

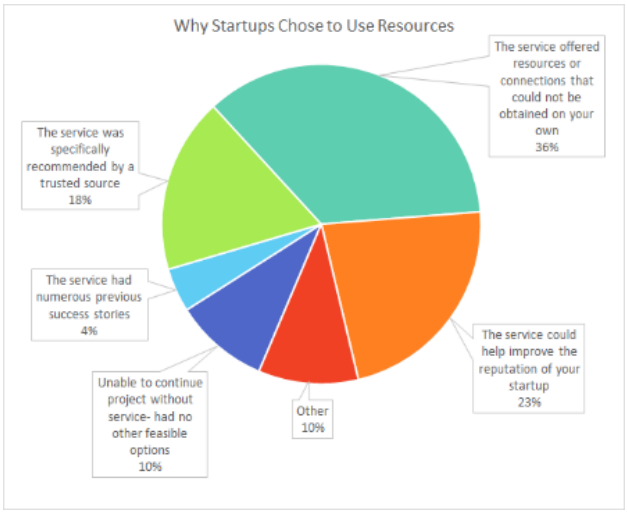


Figure 28: Why startups chose to use resources, n=41.

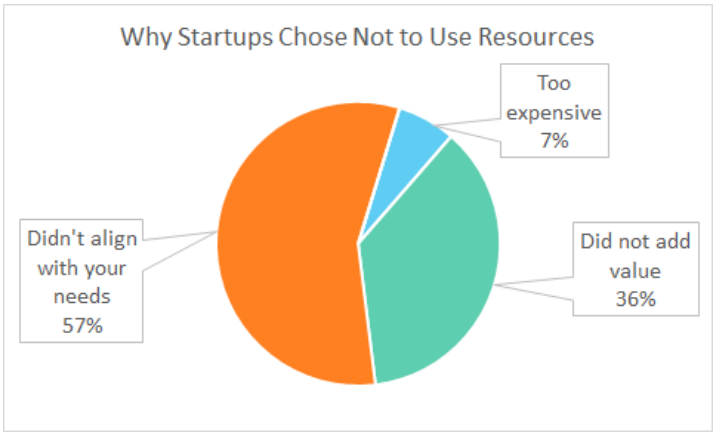


Figure 29: Why startups who did not use resources decided not to do so, n=5.

F.7 Usage of Specific Resources

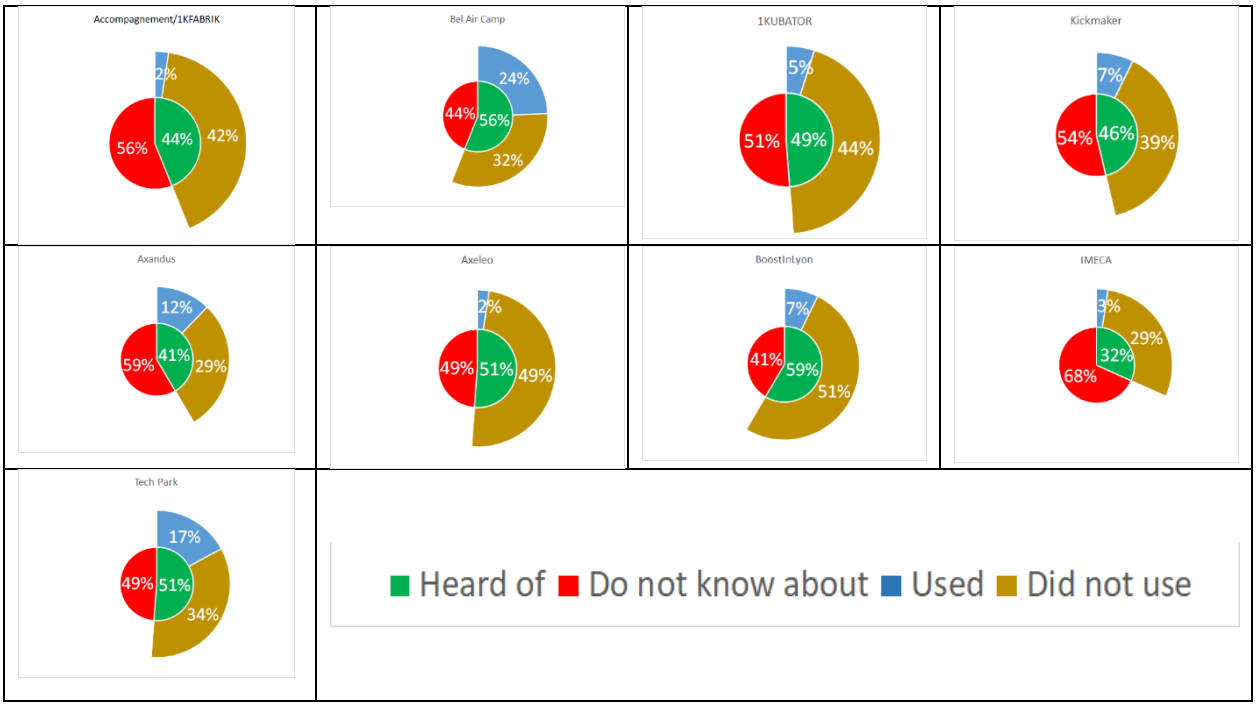


Figure 30: Usage and knowledge of specific resources. The inner circle depicts whether startups have heard of each resource. The outer ring shows what portion of the respondents who knew about the resource have used it. n=40.

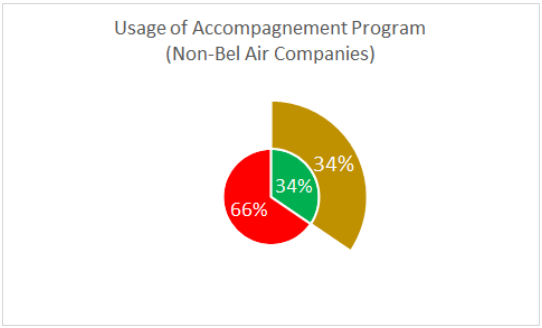


Figure 31: Usage and knowledge of the Accompagnement Program by startups who are not located at Bel Air Camp, n=29.

F.8 Textual Responses

Original Response	*English*
“Hors de prix”	Overpriced
“pas besoin aujourd'hui”	no need today
“Parce que cet Accompagnement, lorsqu'il a été créé, ne correspondait pas à l'étape de notre entreprise.”	Because this support, when it was created, did not correspond to the stage of our company.
“Spécifique à 1KUBATOR, on était à [incubateur] nous.”	Specific to 1KUBATOR, we were at [incubator].

“Arrivé trop tard à [ville] à notre stade de développement”	Arrived too late in [city] at our stage of development
“Tarif/service”	Price/service
“Car nous ne faisons pas partie d'1KUBATOR et qu'au moment où nous sommes arrivés à Bel Air, nous avions passé l'étape "prototypage"”	Because we are not part of 1KUBATOR and by the time we arrived at Bel Air we had passed the "prototyping" stage
“nous étions déjà lancé quand nous sommes arrivés”	we were already launched when we arrived
“Bel Air Camp est un très bon programme, mais [incubateur] nous as fait une meilleure proposition, et nous permet davantage de connexion pour accélérer notre business”	Bel Air Camp is a very good program, but [incubator] has made us a better proposal, and allows us more connection to accelerate our business

Table 8: Textual responses about why startups have not used the Accompagnement Program, with translations in the right column.

Original Response	*English*
“Trop cher par rapport à notre stade de développement lorsque nous nous sommes approchés d'eux.”	Too expensive compared to our stage of development when we approached them.
“trop software”	too much software
“Car ils n'étaient pas implantés à Lyon à l'époque.”	Because they were not established in Lyon at the time.
“On est parti à [incubateur] plutôt car ils ne prennent pas de capital de l'entreprise mais proposent un Accompagnement au forfait, ce qui nous plaisait plus.”	We went to [incubator] rather because they do not take capital of the company but offer a package support, which we liked more.
“Arrivé trop tard à [ville] à notre stade de développement”	Arrived too late in [city] at our stage of development
“not free”	not free
“Trop cher”	Too expensive
“Didn't find proof of market yet.”	Didn't find proof of market yet.
“Modèle économique”	Economic model
“didn’t know at that time”	didn’t know at that time

Table 9: Textual responses about why startups have not used 1KUBATOR, with translations in the right column.

Original Response	*English*
“nous avions les compétences en interne, du coup quel aurait été le sens d’utiliser un intermédiaire et ne pas développer de propriété intellectuelle propre ?”	we had the skills internally, so what would have been the point of using an intermediary and not developing our own intellectual property?
“quelle valeur ajouté ?”	what value was added?
“Pas adapté lorsque nous l'avons découvert”	Not suitable when we discovered it
“ne connais pas”	don’t know it
“pas besoin aujourd'hui”	no need today

“Parce qu'ils ont des connexions en Asie, peur de la copie”	Because they have connections in Asia, afraid of copying
“Pour le moment nous n'en n'avons pas eu l'occasion mais nous avons des synergies à exploiter pour le développement de nos prochains projets”	At the moment we have not had the opportunity, but we have synergies to exploit for the development of our next projects
“No ready yet.”	Not ready yet.
“not relevant”	not relevant

Table 10: Textual responses about why startups have not used Kickmaker, with translations in the right column.

F.9 Usage of Different Technologies

Technology	*Mean:*
Software/App Development	2.53
Electronics	2.51
Sensors	2.40
Mechanics	2.15
Plastics	2.13
IOT	2.11
Metalwork/Machinery	1.87
Robotics	1.62

Table 11: Extent to which different types of technology are involved in the startups’ products, on a scale of 0 to 3 with 3 being the most important, n=46.

Appendix G: Case Studies

Austin Technology Incubator (ATI) is a successful incubator that is specifically designed for hardware startups. The incubator was started in 1989 and has been effective in creating lasting companies and helping the local economy. ATI was formed in Austin, Texas by the University of Austin, local businesses and government. ATI has created 65 companies, helping create 2,850 jobs and has won several awards. ATI has won the National Business Incubation Association (NBIA) Incubator of the Year several times. Four the companies it helped found have also won NBIA incubator company of the year (Gibson, Wiggins, 2003, page 60).

There have been several factors crediting ATI's success. The first step to success is defining what a successful hardware startup is. The NBIA has "industry-wide priorities include creating jobs, creating new business, reducing business failures, accelerating business success, generating capital investment, and leveraging funds" (Gibson, Wiggins, 2003, page 61). Each incubator will also have their own vision of success. ATI looks at three relevant criteria. They first look at the companies entering the incubator. The companies must be promising and technology-focused. Secondly, ATI helps supply funding for their companies. ATI has been successful in raising $300 million for the companies in the past. Lastly, ATI defines success as bringing the product to the market (Gibson, Wiggins, 61, 2003).

The second step to success for ATI is to create services that help the companies that work with ATI. The incubator must design these services to be helpful able to be delivered in a timely manner to the hardware startups. ATI states they have strategic, operational and infrastructure services (Gibson, Wiggins, 2003, page 62). They provide strategic mentors, helping build a business model and funding approach. To assist in operational development, they provide professional services. The infrastructure provides space to work and other services to increase the time companies can spend working. ATI states it is important to focus on select services and commit to perfecting the timing and quality of these services (Gibson, Wiggins, 62, 2003).

The third process ATI uses is developing criteria and a selection process for businesses to join ATI. The success of an incubator is based on the success of a company and they must choose the right companies. In order to ensure that the right companies are applying, written and oral applications are completed onsite at ATI. The review process will take place externally and internally to ensure the company is receiving a fair application (Gibson, Wiggins, 2003, page 64). The whole process must be clearly communicated and flexible to allow for unusual situations.

The fourth criteria for a successful incubator is getting capital for startups in the incubator. ATI has a notable method to get capital. This is an important step to the success of hardware startups because without any capital the ideas will never be prototyped or manufactured.

HAX is one of the world's first hardware incubators based out of Shenzhen, Guangdong, China (Avle, Lindtner, Williams, 2017). HAX is unique in that it has designed a program specifically for hardware startups. Its program begins in Shenzhen, where the hardware startups focus on the idea to prototype phase. The next phase, bringing the product to market, is then done in San Francisco, USA ("HAX", 2018).

When it comes to agreeing upon a design for manufacturing, understanding how the design will be manufactured is crucial. Almost any design can be prototyped, since you only need to make one. Although, mass-producing a design will require the designer to know what is required by the design to make it cost-effective to manufacture many of them. HAX's strategic location in Shenzhen is geographically close to inexpensive hardware products as well as inexpensive manufacturing (Bateman, 2017). The interactions with manufactures that HAX promotes allows hardware startups to learn firsthand the requirements of designs that will be manufactured. Through feedback from manufactures, the product design will cycle through multiple iterations until one can be agreed upon that is both functional and manufacturable (Bateman, 2017). HAX also offers "other services useful for budding entrepreneurs, including business-plan development, pitch preparation, government-relations management, and mentoring. The accelerator also brings in experts in fields including manufacturing, robotics, electronics, engineering, industrial design, sourcing, branding, graphics, video making, and storytelling." (Bateman, 2017, paragraph 24). To ensure that the hardware startups can focus on designs for future product development, HAX provides $100,000 to hardware startups for about 9% equity in their companies (Bateman, 2017). This helps the hardware startups promptly begin work and design a feasible prototype to then pitch to larger investment platforms, like venture capitalists or crowd funding. Lastly, HAX has made itself known to be excellent at solely hardware and most specifically, product development for mass production in China. Focusing on its own strength has been a successful strategy, as opposed to trying to make its reach broader, beyond hardware.

Appendix H: Interview Data from Resource Centers

	Service Provided	How it got started	Systematic Process	What Resources they Provide
1KUBATOR	incubation for a startup, provide funding, workshops, business support, company branding	places around France, Lyon opened in three years ago	flexible Gantt chart for a two-month period for the set time, ITERATIVE PROCESS, 1KSTART, 1KCONNECT, 1KMARKET, 1KPUSH	connections with companies, website building, funding, support, workshops, set program
Piwio	PCB design Biomedical sensors	PhD students that had experience with biomedical sensors in the INL team at INSA Lyon. Patented mouth-guard there	Agile Development Methodology	connections with manufacturers. Work with startups on MVPs that can be mass produced to then show to investors and get funding.
Kickmaker	Mechanical and electrical experts Connect with manufacturers in China	Already set up in Paris, started in Lyon as the hardware ecosystem here is new	Agile Development Methodology, if clients have a good POC	Help with business model if does not exist or does not work, mass production, sometimes prototyping as well
Beelys	CampusCreation & LSU- startup creation contests; DZE-program which offers makerspace, mentors, seminars, and commercial/fina	Program run by Université de Lyon	use principles of design thinking but not the "official" process, individualized help for each startup, have several defined entry times	help with prototyping and business, mentoring, space with tools, connections

	nce/prototyping advisors; JEA-accelerator		throughout the year where people can join after having an interview with a panel of judges	
Key takeaways for incubators	Incubators provide a wide range of funding which help business aspect	Run by different companies for different reasons- one for different companies while one is for students for a year	individual process based on the resource and what service they provide	All focused on mentoring, connections and providing resources

	Their opinion what Hardware startups need the most	**How they Attract Hardware**	**Connections in Ecosystem**
1KUBATOR	they cannot provide that service there, so they said they need help prototyping	not really, most companies fill out the form to be a part of the program, already have customers for the accelerator, they use networking and events	bel air camp, larger companies, mentors
Piwio	Help with creating a prototype that can be mass-produced	Success stories, website, Acquaintances from school (very close networks to start with)	Manufacturers in China, INL biomedical sensors team at INSA Lyon, Manufacturers in France, friends from INSA involved with mechanical design
Kickmaker	Building a prototype that can be mass produced. On second thought, funding as well	Previous connections of people who work there, LinkedIn, networking events Startups come to them	Manufacturers in China, H7, Foxconn, Tesla, French Fab (Paris)
Beelys	Accompagnement is very important,	website; talks at the university where they	universities (Université de Lyon,

	startups need to go through many iterations of prototypes before they can get to the final one	try to spark interest in entrepreneurship and tell students that anyone can start a company and that they can help	INSA, Lyon A, Lyon 2), FEE
Key takeaways for incubators	one could not help hardware startups, while the one with prototyping stated getting help and many iterations are key	strategy depends on their purpose and how well known they are	often large network with varying to support their needs and people who they help

Table 12: Results from interviews with resource centers.

Appendix I: Survey Design and Results

This section will discuss our takeaways concerning our survey design and distribution methods.

- Not random and sent to specific people; we could have missed send to specific population
- Should have made it shorter since about 20 people did not fill it out completely
    - We received an email about how it was too long
- Have important questions at the beginning of the survey so we still get more of these responses even if people don't finish- this is more important than chronological order like we were using
- Come up with a way to ensure a random sample, by finding many different sources of startups (resource centers, conferences, etc.)
- Need personal connection to resource centers, otherwise they are unlikely to help distribute the link
- Avoid big matrix questions