Diagnostic Playbook

Translation from the Lab

DEC 6, 2020

ENGAGEMENT GROUP
HORIZONS, DIAGNOSTIC PILLAR
MGB CENTER FOR COVID INNOVATION

"Seeing your research published is always exciting but when your research results in impactful products that improve healthcare, you know you've made a difference." – David Walt

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Deciding on the best path forward

Knowledge that benefits the health and welfare of others is of no consequence unless shared. The process of sharing such knowledge can be accomplished in many ways. For example, a peer-reviewed article in a leading journal may provide all the impetus needed to change clinical practice and improve care.

However, it is frequently the case that further research, translational studies, regulatory approval, manufacturing, sales/marketing, and distribution are necessary to effectively share new inventions and materially change healthcare decisions or healthcare delivery. The process for determining these steps is best accomplished through careful consideration of the scope of the knowledge, the related factors to effective sharing and the level of control needed to ensure success. The pathway(s) selected can make a significant difference in spreading knowledge and affecting change.

The summary information presented here is based predominantly on experience (both good and bad), knowledge of what works in a negotiation (and what likely won't) and a series of excellent articles in Nature Biotechnology authored by Sadhana Chitale (NYU Langone Medical Center), Colm Lawler (Tufts University; Mass General Brigham) and Scott MacFarlane (SUNY Upstate Medical Center).

Once a discovery or advance in thinking is achieved, it is important to determine whether this new information is best advanced as intellectual property (IP) or openly published to the community. This decision is not always a philosophical one concerning pure academics versus commercialization. Much of translational science requires continued investment to reach the clinic. In the absence of IP available for licensing, investment capital is often difficult to find thus limiting the progress of an idea. The 2020 article by Chitale, et al., "Understanding the basics of patenting", provides a concise overview of the patenting process and the underlying decisions on filing a patent.

Once an IP strategy has been agreed upon, there are three main paths to consider for out-licensing. One can negotiate an exclusive license with an established entity, large or small, that is already successful in the anticipated market. Alternatively, one can exclusively license the IP to a new company (NewCo) created specifically to commercialize the IP or as part of a broader NewCo effort to enter the relevant market. An alternative approach is a series of non-exclusive licenses with a number of relevant companies selected to make the IP broadly available in the marketplace. Selecting among these options requires a thoughtful approach balancing the risk of success with the return on investment for each path.

As with many guides, the information provided here is general advice for the academic inventor, and with all advice, there are exceptions to the guidance. The most important part of translation is to find a problem worth working on and driving towards impact. There are several paths to reach any goal.

HOW TO DECIDE ON A LICENSING PATH

There are several factors involved in making a well-reasoned decision regarding where and how to license IP. There is also some helpful market data to be collected supporting a decision and, depending upon the outcome, execute on the licensing plan. The following checklist includes factors to consider, necessary supporting data, tolerance decisions and desired financial outcomes. No such list can be comprehensive for all situations but knowing as much of this information as possible will provide a good start.

Table 1. Key Questions for Translation

Question	Startup Importance	Out-License Importance
Unmet need or problem being addressed?	Answers the "Why do this at all?" question	Answers the "Why do this at all?" question
Who has this need/problem?	Addressable market data	Addressable market data
Who currently delivers this solution?	Addressable market data Market research reports	Addressable market data Market research reports
At what stage is the solution? **Concept?** **Early prototype?** **Proof of Concept Data?** **Validation Data?**	Provides investors with the level of risk to investment and the timeframe involved	Provides licensee information on what additional in-house investment is needed and how open to change the solution remains.
How similar is the approach to existing products?	Competitive advantage	Competitive advantage
Does the approach answer a single need or is it a platform to answer other needs?	The difference between a single product and a future product line supporting an entire company	Could be additive to an existing product line or create another entire line using existing infrastructure
Who competes in this market?	Risk to success in competition with a better funded competitor. If no competition, risk to build that market from scratch.	List of potential licensees. Licensee may want an advantage over competition. Lots of competitors may change the value of the IP
How big is the market?	Detailed data needed on addressable market (all potential users), target market (subset of likely users at start), adoption ramp (related data on likelihood of changing current practice)	Top-level data on market. The licensee will have their own opinion on how valuable the market is to them.
Pricing/Reimbursement	Cost of goods, cost to manufacture, acceptable margin by market, reimbursement environment for solution	Cost of goods, cost to manufacture, acceptable margin by market, reimbursement environment for solution
Regulatory requirements	Level of regulatory rigor needed concerns needed funding and timeline.	Level of regulatory rigor needed concerns needed funding and timeline.
Management	Are the academic inventors leaving to form the company? If yes, what makes you think they will succeed? If no, do they have an experienced entrepreneur to take this on?	Does the licensee have experience in developing and marketing such a solution? Do they have the market presence to be competitive?
Budget	What is the investment needed to further develop? What does an exit look like?	What budget would be necessary to add this product to the licensee's product line? Does the licensee have that financial ability?
Intellectual Property Strategy	What type of IP do you need for a startup? How will you protect the newco from competitors?	What IP will be needed for company interest?

Licensing strategy	Exclusive is most likely. If not, need a clear rationale to start a new company without that competitive advantage.	Does exclusivity meet the market needs? Is the ask for an exclusive license based in a desire to remove a competing product? Would a non-exclusive license increase or decrease the likely development and distribution of the product?

One of the key factors to think about early on is "market pull" for the technology that you are developing. For example, is this an easily identifiable pain point in the industry, or is it challenging to describe? What are customers currently doing now, instead of using your solution? What are the barriers to entry, and how can you address them? Understanding the customer in detail and their needs is incredibly helpful to determining the commercialization path for a technology. Having the right tech at the right time that the market needs your solution can make your efforts much more likely to succeed.

Another key factor is whether your technology is an incremental improvement over existing options or is it a "game changer?" Commercializing technology can take a long time, so it is important to work on solving worthwhile problems. There are additional questions needing answers depending upon the specifics of the IP and market. The more information available to the process the better the outcome.

THE STARTUP PATH

Once the internal diligence efforts described above are complete and an informed decision made that a NewCo is the desired path forward, a number of follow-on decisions to be made become apparent. Who will be leading this effort? Will the inventors be leaving their current role(s) to join the NewCo? How will the NewCo be funded? What involvement, if any, will the licensor have in the NewCo? These are the most basic of questions to ask prior to taking the legal steps to form the NewCo. We recommend consulting with an atty to help with the process. The IP will be licensed to that NewCo by the inventors. Licensing team at their home institution. They will not be representing the NewCo and the inventor cannot sit on both sides of that fence without running into a conflict of interest. There are many additional details, essential and mundane, that an experienced corporate attorney can assist with and guide the new entrepreneur in the early days of the NewCo. The 2018 Chitale, et. al. paper on the myriad types of agreements available to the academic entrepreneur provides a brief overview of the importance of having an experienced hand direct the NewCo's earliest agreements. Placing your IP in the hands of a startup is fraught with risk. It can result in remarkable success, both for the technology and for the founders and investors. It can also end in utter failure with no return on the hard work the inventor may have made throughout their career. It is important to understand the tolerance for that level of risk before making the decision to choose a startup path.

THE LICENSE PATH

The choice to out-license IP to an established entity can be made on the basis of many factors. The vast majority of those factors revolve around the risk profile if the IP is commercialized in any other manner. The details may involve adding the IP to an established pipeline, better distribution and market access, funding to further develop the product, access to enabling IP not developed by the inventor, a desire to place the IP in the hands of a proven company in a relevant market or simply moving the IP into a company that can manage it without any further input by the inventor. These all involve a determination that the benefits of executing a license are greater than the

benefits of starting a company. Chitale, et. al. (2016) provide an detailed overview of the factors involved in striking a licensing deal.

A final comment on licensing, not all IP is best served through an exclusive agreement. Many institutions will only license technical information (often called know-how) non-exclusively in order to foster the distribution of knowledge broadly. The decision on non-exclusive versus exclusive licensing is best made in consultation with your institution and licensing experts.

FUNDING YOUR WORK

The fuel that supports scientific advances has always been the funding underlying the research. Salary support, reagents, consumables, indirect costs essential to creating a safe environment in which to work and all the minor details that, collectively, mean the difference between success and failure. This document will not go into detail on the wide variety of funding agencies available to the academic investigator depending on where you are conducting that work. Well known national resources such as the US National Institutes of Health, European Commission, UK's Medical Research Council, INSERM, US Department of Defense, Canadian Institutes of Health Research, Australian National Health and Medical Research Council and the German Research Foundation (DFG) all have well established funding mechanisms.

Large philanthropic groups such as the Wellcome Trust, Howard Hughes Medical Institute, the Bill and Melinda Gates Foundation, Institut Pasteur, and the Rockefeller Foundation can provide significant support according to each group's mission. In addition, there are COVID-19 specific opportunities including the RADx grant from NIH and XPrize Rapid COVID testing award.

Many large academic medical centers have productive Charitable Giving or Development departments managing gifts and other donation types. Such funds are often used to support specific research according to the donation focus, for example a specific disease or patient group. They may also be more broadly defined to support a wide variety of research efforts from early, difficult to fund, proof of concept experiments to gap funding covering periods between successful funding by the groups previously mentioned. Many institutions will host grant competitions to determine the best project deserving funding. It is strongly encouraged to check with the Development Office in your institution for programs they may support.

Corporate support for research can take the form of Sponsored Research Agreements or Institutional Service agreements. These sources of funding are normally targeted to a specific statement of work and expected deliverables on an agreed upon timeframe. Knowing what kind of work you will do with a corporation, how they might control the direction of that research and understanding their control of future publications are important parts of developing a relationship with a company and creating a beneficial statement of work. Your tech transfer office can assist with the negotiation of such agreement.

Intellectual Property

TYPES

There are four main types of intellectual property: patents, trademarks, copyrights, and trade secrets. In this section, we will focus on patents.

PATENTS:

Patents provide an exclusionary right, which means that patents can be used to exclude others from making, using, selling, offering to sell, or importing any invention that is covered by an issued claim. Patents do not guarantee the right to make a specific product. Patents can be very helpful in the commercialization process because there are an asset that the university can use to grant rights to companies. In the US, the standard term of the patent is 20 years from the non-provisional filing date.

Two main types of patents that typically apply to diagnostics technologies.

- Utility patent: covers a product, process, or machine.
- Design patent: Covers the visual characteristics of a product or machine, but not the way that the product or machine works

In our experience in academic settings, utility patents are the most common for diagnostic inventions. Design patents typically come later in the commercialization process, if the inventor is creating novel hardware and knows the form factor of the device.

A utility patent may cover a process or a specific diagnostic product. One of the most famous molecular biology technique utility patents is for PCR https://patents.google.com/patent/US4965188 (see figure below).

Patents go through several stages before they are granted. Any patent that is not grant can be referred to as “patent pending.” Figure 1 provides one example of the steps in a patent process (you may be advised for a slightly different path, based on the particular strategy for your invention).

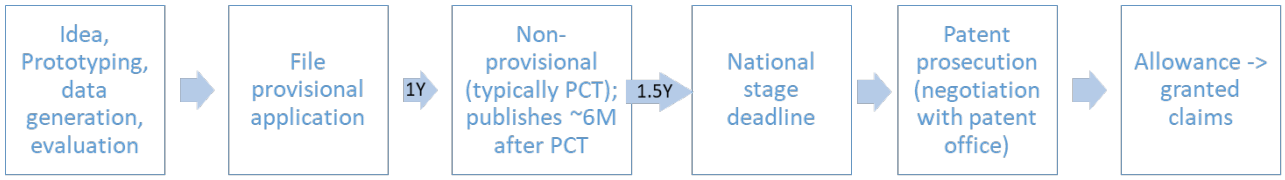
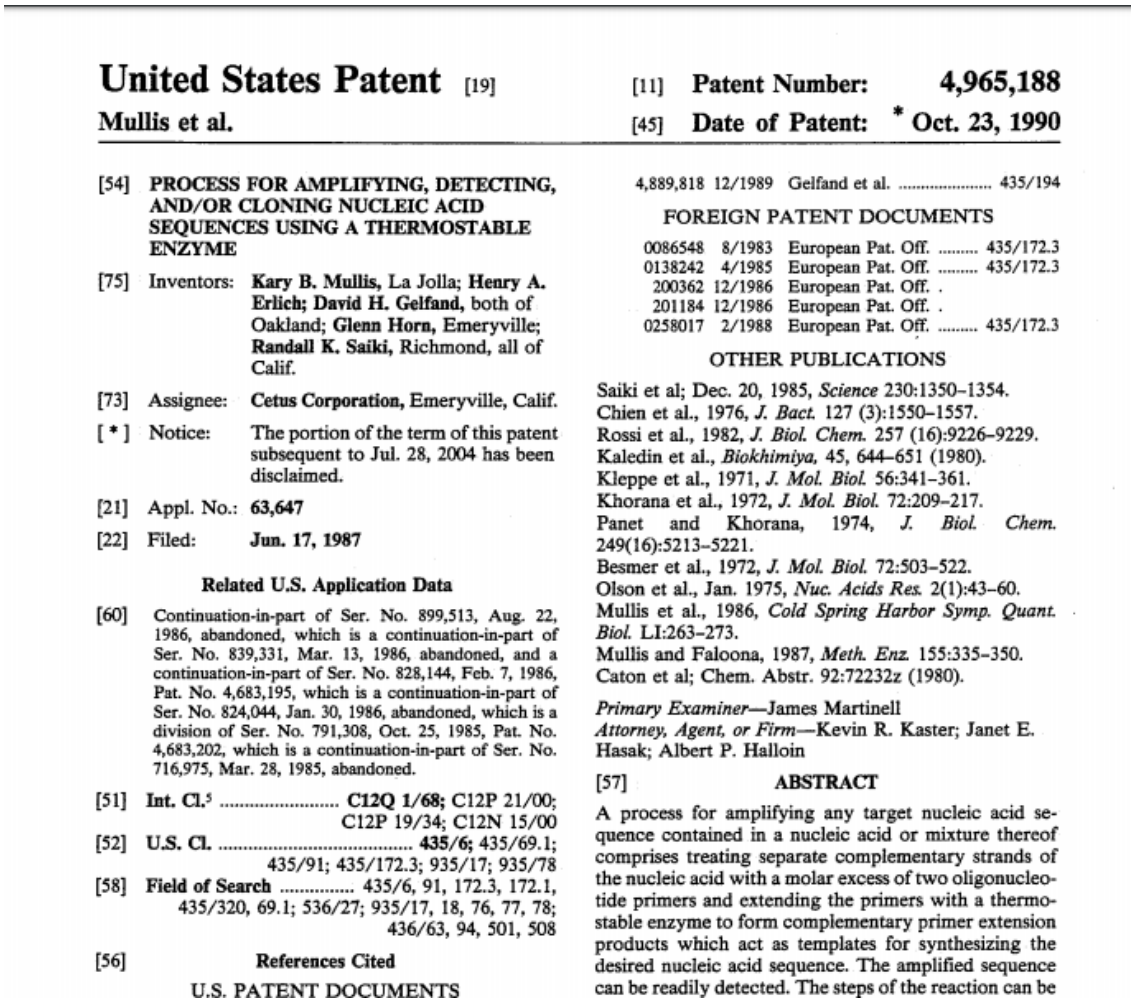


Figure 1. Patent filing process



United States Patent [19]

Mullis et al.

[11] **Patent Number: 4,965,188**

[45] **Date of Patent: * Oct. 23, 1990**

[54] **PROCESS FOR AMPLIFYING, DETECTING, AND/OR CLONING NUCLEIC ACID SEQUENCES USING A THERMOSTABLE ENZYME**

[75] Inventors: **Kary B. Mullis**, La Jolla; **Henry A. Erlich**; **David H. Gelfand**, both of Oakland; **Glenn Horn**, Emeryville; **Randall K. Saiki**, Richmond, all of Calif.

[73] Assignee: **Cetus Corporation**, Emeryville, Calif.

[*] Notice: The portion of the term of this patent subsequent to Jul. 28, 2004 has been disclaimed.

[21] Appl. No.: **63,647**

[22] Filed: **Jun. 17, 1987**

Related U.S. Application Data

[60] Continuation-in-part of Ser. No. 899,513, Aug. 22, 1986, abandoned, which is a continuation-in-part of Ser. No. 839,331, Mar. 13, 1986, abandoned, and a continuation-in-part of Ser. No. 828,144, Feb. 7, 1986, Pat. No. 4,683,195, which is a continuation-in-part of Ser. No. 824,044, Jan. 30, 1986, abandoned, which is a division of Ser. No. 791,308, Oct. 25, 1985, Pat. No. 4,683,202, which is a continuation-in-part of Ser. No. 716,975, Mar. 28, 1985, abandoned.

[51] **Int. Cl.**[5] **C12Q 1/68**; C12P 21/00; C12P 19/34; C12N 15/00

[52] **U.S. Cl.** **435/6**; 435/69.1; 435/91; 435/172.3; 935/17; 935/78

[58] **Field of Search** 435/6, 91, 172.3, 172.1, 435/320, 69.1; 536/27; 935/17, 18, 76, 77, 78; 436/63, 94, 501, 508

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[57] **ABSTRACT**

A process for amplifying any target nucleic acid sequence contained in a nucleic acid or mixture thereof comprises treating separate complementary strands of the nucleic acid with a molar excess of two oligonucleotide primers and extending the primers with a thermostable enzyme to form complementary primer extension products which act as templates for synthesizing the desired nucleic acid sequence. The amplified sequence can be readily detected. The steps of the reaction can be

Figure 2. PCR Patent

CLAIMS

One of the most important parts of the patents are the claims because the claims provide the exclusionary right, and we recommend careful review of the wording of claims with your tech transfer office and attorneys. In this patent, there are two types of claims, independent claims and dependent claims. Independent claims are stand-alone and dependent claims will reference the independent claims.

Example Independent Claim from the Mullis et al. PCR patent

1. A process for amplifying at least one specific DNA sequence contained in a DNA or a mixture of nucleic acids, wherein if the DNA is double-stranded, it consists of two separated complementary strands of equal or unequal length, which process comprises:

(a) contacting the DNA with four different nucleoside triphosphates and two oligonucleotide primers, for each different specific sequence being amplified, wherein each primer is selected to be sufficiently complementary to different strands of each specific sequence to hybridize therewith, such that the extension product synthesized from one primer, when separated from its complement, can serve as a template for synthesis of the extension product of the other primer, at a temperature which promotes hybridization of each primer to its complementary strand;

(b) contacting each strand, at the same time as or after step (a), with thermostable enzyme which catalyzes combination of the nucleoside triphosphates to form primer extension products complementary to each strand of DNA; (Edited for length…..)

Example Dependent Claim from the Mullis et al. PCR patent

2. The process of claim 1, wherein one specific DNA acid sequence is amplified and two primers are employed.

INVENTORSHIP VS. OWNERSHIP

An important point for any inventor to understand, is the difference between an inventor and the assignee of the patent. An inventor is one who contributes to the conception and reduction to practice of one or more of the claims in a patent application or patent. It is very typical for employers to require that the rights to inventions created by their employees during their employment are assigned to the employer, the assignee.

ROLE OF THE TECH TRANSFER OFFICE

Patent execution, maintenance, licensing discussions and related expenses and subsequent revenue, if any, become the responsibility of and accrues to the employer. Consideration of the expenses likely to be involved and the commercial potential of the invention often drive these initial discussions. The inventor has a key role to play in these early decisions. A full description of the invention, examples of how it could be used and thoughts on how it might be commercialized are all important contributions to the decision making process.

Maintaining a clear-eyed view of the reality of the market potential (large, small or non-existent) will help those tasked with executing on the steps towards that potential. Identifying additional IP potential to strengthen the position of the overall IP portfolio is also an important conversation between the inventors and those managing the portfolio of inventions. How do additional experiments, proof of concept or clinical data assist/enhance the commercial value demonstration of the IP? What kind of funding would be needed to accomplish those goals? Generating a plan addressing these questions is often an exercise falling between a grant application and a business plan. The academic inventor is familiar with the former and, usually, not the latter. Working closely with an Innovation Office, Tech Transfer Office, Business Development team or Entrepreneur-in-Residence can help with the mix of information, budget request and convincing argument needed at this stage. Interactions with these offices, teams and individuals often require new ways of thinking about the impact of an investigators work, how best to foster its growth and difficult decision making. Chitale, et. al. (2013) describes a view of this process from the Tech Transfer/Innovation Office perspective.

Collaborations

Collaborations with industry can be a helpful way to move projects towards commercialization. The key to collaborations is to set up a mutually beneficial arrangement. For example, a company may want to create a more sensitive RNA test for coronavirus. An academic lab may have developed a novel tech to meet this need, but needs help integrating their tech into the clinical lab workflow on an existing QPCR machine. The company and academic lab could work together to integrate the RNA detection assay into the clinical QPCR work flow, and if this is successful, the company could license the technology for use on their QPCR system.

Prior to initiating conversations with a company, academic scientists should first talk to their tech transfer office about intellectual property, confidentiality, and process for engagement. In addition, the tech transfer office may be able to provide introductions to the right people at the company to facilitate the interactions. The inventor is also encouraged, in coordination with their tech transfer office, to personally engage their network of industry colleagues who might be interested in the technology. It is also helpful for the inventor to identify for the tech transfer office those companies already involved in the relevant market as potential collaborators of interest.

SCOPE

The first step to defining a collaboration is to determine the goals for each side and the scope of the work. This process is typically described in a "statement of work" or "work plan". There may be some work completed at the academic lab and some work done at the company. If the industry sponsor agrees to fund the work, then a budget would also be developed and agreed upon. Scientists and industry partners typically collaborate and review the work plan.

FUNDING

Industry partners can provide funding for translation work under sponsored research agreements. The level of funding can vary widely from thousands to millions of dollars, depending on the scope of work.

AGREEMENTS

The full process is reviewed in Chitale et al. 2018 for a more detailed look. At the beginning of the discussions, academic labs may wish to share confidential information with a company (for example, a patent that is not yet published). If so, please contact your tech transfer office about intellectual property considerations, prior to talking to a company. The tech transfer office may put in place a "confidential disclosure agreement".

Confidential Disclosure Agreement (CDA), Non-disclosure Agreement (NDA): This type of agreement covers the handling of confidential information. Check with your tech transfer office for specific policies.

After the statement of work and budget is agreed upon, the tech transfer office at the university will negotiate an agreement with the company.

Common types of collaborative agreements:

Material transfer agreement / Evaluation agreement: The company transfers materials to the academic lab or the academic lab transfer materials for the company. A work plan is carried out and results may be exchanged at the end of the agreement.

Collaboration agreement / sponsored research agreement / Service Agreement: Work may be completed at the academic lab and the company. Materials may be sent back and forth, as part of the work. Results are shared at the end of the project. The company may provide funding to the academic lab. Companies may have an option to license intellectual property related to the project.

KEY QUESTIONS TO DISCUSS WITH YOUR TECH TRANSFER OFFICE:

- What type of agreement do you recommend?
- What are your expectations for a statement of work or work plan?
- Can you describe the budgeting/overhead process to me?
- What are my obligations under this agreement?
- How can we best protect the IP for this project? How will IP be addressed in the agreement?
- Will the company have any rights in my IP? Will they have an option to license it?
- What if we invent with the company as part of this work? How will the joint inventions be handled?
- Who will own results or data from the project? What is the process for sharing results? How can results be used?
- Are there any restrictions on publications? Will the company have the right to review my submission before publications? Can I present the results at a conference?

Licensing

UNMET NEEDS FOR COMPANIES

Licensing is one path to seeing your invention become a marketed product. It is important that that you identify unmet needs of diagnostic company partners that would be of interest. These are generally tasks or initiatives that they cannot do themselves. For many of the larger diagnostic companies, incremental improvements to existing portfolios will likely not be sufficient to gain any interest. This includes incrementally more sensitivity or specificity to existing testing or slight improvement in the cost of goods. However, if an invention is a large improvement on a piece of a product or a step in a process, it is probably more appropriate to license it rather than start a new company. A new company would need freedom to operate on many aspects of the product not covered by the patent and it may therefore be best choice to partner with existing market player than to start from scratch.

More interesting would be significant advances or gap fillers, such as more rapid or more accessible testing. For example, if the gold standard diagnostic test is centralized, a bedside test that could be performed in an office setting could be much more interesting. There are emerging areas of high unmet need as a result of the recent pandemic. Such areas include everything from respiratory panels to contactless screening. Companies are particularly interested if the new tech could benefit from their existing sales channels and distribution or is synergistic with their existing business.

Another key factor to think about in commercializing your technology is defining if your innovation is a product, platform, or a process (or some combination of the three). For example, you may be improving on an isothermal amplification protocol, which is a process, but you may be able to claim the components that are needed for your new reaction as a kit (product). It is also important to think about if several products could be developed from your innovation, or if only one product can be developed.

OUTREACH

We suggest you solicit input from scientists at several potential partners to determine what they believe would be of strategic interest. Many scientists at the larger companies enjoy discussions of newer technologies and may help you determine if your technology provides a major improvement to an existing product or if it may fill a gap which would enhance the product line/portfolio. If there is interest, your scientific contacts could also be a great champion for a potential business relationship and may connect you to their business development colleagues.

If you would like to speak to a specific company about your tech, first reach out to your tech transfer office for help, advice, and introductions. Scientific conferences can also be a great way to meet scientists at companies. During poster presentations, having a non-presenting laboratory member stand with the poster viewers can be a great way to initiate conversations or gauge interest level in the presented technology. LinkedIn and other social media platforms can be helpful to make initial contact and set up a conversation.

Typical questions that you could ask an employee at a company:

- Tell me about your role
- What are your key interests
- What are obstacles you encounter
- What would be a major advance to your company/ industry in general

REQUIREMENTS FOR LICENSING INTO AN EXISTING COMPANY

Licensing your invention to a partner with resources to fully develop and commercialize a novel product can be exciting. In addition to financial rewards which come from payments for access rights to the invention, there is satisfaction in seeing your invention help people as part of a larger offering of products. The licensing process is often done in parallel with other sources of funding. You will need to work closely with your IP and business / technology development colleagues and will need a lot of patience in order to accomplish this as this process can take several months. It is also important to have a realistic view of the commercial potential of your invention. The Mullis et al. intellectual property noted earlier won a Nobel Prize, changed the diagnostic industry and enabled testing to be done where there was none before. That outcome is not the norm for diagnostic inventions.

Key considerations:

(1) It is important that you file to protect your IP before publishing your inventions. Any scientific journal submission or presentation should be reviewed by your IP colleagues first. The primary value driver of a license is access to the patent which may be exclusive to one company or non-exclusive to multiple companies. As you work to improve your invention during the licensing process, it is important to work with your IP colleagues as additional patent applications may be warranted.

(2) Strategic fit and alignment are important. Larger diagnostic companies have different goals and will not all have the same desire to license. Your business colleagues will help you focus your efforts on the companies that have the best alignment.

(3) You should prepare a pitch deck (see other sections for more detail on this). This deck includes only non-confidential information. You may want to customize the pitch for each company. The initial deck is usually 8 – 12 slides, brief enough so that it will be read. Keep in mind, this is not a full disclosure of information, just a solicitation regarding the potential of your invention and the unmet needs addressed. If there is interest, a confidentiality agreement is typically signed and a more comprehensive disclosure then takes place.

(4) Understand and be realistic regarding your competitors. Licensors usually evaluate multiple competitive solutions and you should address the competition and potential advantages of your technology

(5) As you spend time discussing your technology with potential partners, you will also get feedback which can be used to improve your pitch. This may come from conducting new experiments or from improving how you present the concepts.

(6)Peer reviewed publications provide significant value during the licensing process.

KEY QUESTIONS FOR YOUR TECH TRANSFER OFFICE

- What types of agreements are you considering for this arrangement? What information do you need from me to support the licensing activities?
- What will be included in this agreement? Patent rights? Materials? Know-how?
- What information will I be required to share with the company?
- How will the relationship with the company be managed over time?
- What if I invent something new related to the license scope? How should we proceed?
- What is the process for distributing revenue?

Startups

KEY QUESTIONS TO GET STARTED

Factor	Questions	Advice
Vision	What is the vision for the newco?	Dream big; it is sometimes easier to get funding for a bigger high-risk idea, than smaller incremental improvement.
Team	Who will carry out this vision? What is their experience?	If you are a first-time founder, try to balance out your lack of experience with advisors and investors who will help; talk to lots of companies/entrepreneurs to learn from their experiences; build a well-rounded team
Advisors	Who will be on the Board?	Develop a collaborative relationship with advisors who can provide the experience and connections to help the team.

		Advisors can also help build credibility for your concept and its future value.
Unmet need	What is the unmet need that you are addressing?	Clearly define the need for your diagnostic product. Make sure that you are filling a market gap
Solution and differentiation	What is your tech or platform or solution?	Describe in a clear concise manner
First Use Case / Product	What product are you making? What is the use case?	Sample use cases are described in the "Use case" section. Understanding the use case, logistics, and customer needs are key to matching your tech with a market gap.
Market	What is the market size? What is the addressable market?	Look at market research reports, SEC filings of diagnostic companies, and news articles for the market size; addressable market is the max sales that your product would receive if there was no competition; contact your tech transfer office for help calculating this number
Competition	Who is the competition? What are their key metrics?	Look at both current and emerging competition; think about project competition and technical platform competition
Work flow	What is my workflow?	Make sure to outline your entire work flow and understand how it compares to current practice
Cost/Pricing/ reimbursement	How much will the customer pay for this? Will I need to obtain reimbursement from insurance companies?	Talk to companies to understand the diagnostic supply chain and reimbursement process; if you are selling to a distributor make sure to account for their mark-up; if you will be in clinic, interview insurance companies to learn about reimbursement For example, investors like to see screening tests that can be made for less than $1
Supply Chain	Who are my suppliers? What do they charge and what are their limitations?	There have been several supply chain issues due to the pandemic; make sure to understand where your materials come from; systems with easy to source components or reagents can differentiate on this point
Execution	How fast can we go?	Move quickly; the market is changing, so teams that can execute fast will win
Technical validation	What data is required for investment?	Data from patient samples is the gold standard; try to obtain samples from local hospitals, companies, or banks. Contrived sample data may be ok from early seed round investment
Intellectual Property	How will I protect my tech?	Coordinate with your tech transfer office on IP
Funding	How will I obtain funding? Grants? Venture capital? Others?	Start speaking with investors early in your process for feedback

USE CASES / VISION

In order to translate your tech into a real world application, it is critical to outline the vision and use cases for your tech and describe why your tech is the best to fit that use case. One key factor in thinking about the opportunity for your tech is to match the stage and timing of development with the risk and opportunity. For example, there will be opportunities for widespread COVID-19 testing in the US in fall 2020. However, many of the current providers are scaling up operations in order to meet these needs. If the tech is early stage, then the opportunity needs to be available in the coming years and that the new tech must be significantly superior in order to receive investment. Investors report that new tech for COVID-19 should receive FDA authorization by fall/winter 2020, otherwise they could become irrelevant. However, they also report that there will continue to be opportunities in certain scenarios. Below is a subset of the feedback that we received on use cases. We encourage tech developers to think creatively and investigate additional scenarios to determine use cases for their own specific tech.

TEAMS

Startups are only attractive to investors because of their plans and their people. Ideas come and go, but strong teams are much more likely to succeed. A diagnostics company has to have focus, deliver a quality diagnostic test and get that product where it is most valued. A successful team must be honest about their progress, their risks and their abilities and be flexible in the face of challenges. All this takes investment, the experience and believability of the team will mean the difference between success and failure in obtaining needed funding. Therefore, it is essential that early in the entrepreneurial journey, company founders think carefully about the team.

How much does the team matter?

While it is common for scientists and engineers to think that their technology is the main driver in an investment decision, investors in the diagnostic arena agree that when making an investment decision, they weigh more the team composition and experience rather than the technology itself. Investors want to see a team able to execute the idea, particularly in the diagnostic field where implementation is critical. The innovation is taking place in a very complex environment, which requires intricate regulatory considerations, market competitive factors, which need to be mastered, as well as interaction with other players. Therefore, investors would like to see a team that is able not only to create a cutting edge technology but also to move this technology through the commercialization path successfully.

Before moving forward, entrepreneurs should be asking themselves two questions:

- Does my team have the experience to commercialize this technology and can we help fill gaps in experience with advice from mentors and advisors?
- Is my team able to convince investors to support our company?

Diversity and Team Formation

Studies have repeatedly shown that increasing diversity on teams increases the financial performance of the company. Having a diverse set of leaders and founders on a team can help create the culture of diversity and inclusion early. Creating a clear mission and set of values that will attract the strongest candidates from a variety of backgrounds will help set the tone for the company.

The Management Team

A regular configuration of an early-stage diagnostic company can be represented by a Chief Executive Officer (CEO) and a Chief Scientific Officer (CSO) or technology officer (CTO) depending on the nature of the innovation. The presence of a Chief Financial Officer might not be required at the beginning. With the progression and growth of the company, new business needs might arise, which will create new functional areas that should be managed, and then further incorporation of such managers can be required. The academic founder should ask their tech transfer office about any policies regarding their ability to serve in a company role, in particular if that role has fiduciary responsibilities. Such roles may create conflicts of interest needing management or restrict the faculty member's ability to serve in that capacity.

The Founder and the Candidates

Early in the life of a startup, the scientific founder have many decisions, candidates to interview and key staff to bring on board. Finding the right people for key roles will mean the difference in funding success, delivery on plans and company success. There are any number of individuals who will put themselves forward as being the positive answer to the company's needs. Generally speaking, a CEO of a startup is involved in recruiting, business development, strategic planning, overall product strategy as well as financial management, investor management, team and corporate development. In reality, a CEO will spend most of their time raising the funds needed to execute on the company's plan. That said, experience in building organizations, a network of potential investors, flexibility in the face of adversity, an ability to strategize in the absence of complete information, a vision for the company (potentially at odds with the founders original vision) and great communication skills are all common traits of the successful CEO.

Formally, the Chief Technology Officer is defined as the executive responsible for the technological needs and the research and development efforts of the organization. Unless a CEO candidate also has deep scientific credentials, a startup will need to recruit a Chief Technology (or Scientific) Officer (CTO or CSO). This individual will be involved in coordinating the R&D efforts, represent the scientific efforts of the company, dealing with the regulatory issues as well as the intellectual property. Sharing in depth knowledge of the scientific founder's technology is essential in making appropriate decisions on a future product. In addition, this individual must have experience in leading highly productive scientific teams. The CSO is often the outward face of the company to the outside world at scientific and technical conferences.

The founder will rely on a few main hires to build a strong team of delivery focused, flexible and engaged individuals. There are numerous resources to draw on to build the proper team. Finding the right initial hires will go a long way towards the future success of the startup

PITCH DECK

Translating your scientific work into commercial success requires different skills from those used to attain scientific success. Expectations, motivations and a tolerance for risk all change when building a commercial enterprise. One of the first tasks an entrepreneur will have is the construction of a short presentation describing your idea and how it can be commercialized, the Pitch Deck. Your idea is no longer a collection of Specific Aims and a long reference list, it is 8-10 slides showing why your idea deserves to become a commercial entity. Short on acronyms, concise in language and visually descriptive, the pitch deck communicates a vision and the confidence that it can be realized.

The language of business

As scientists, engineering or medical professionals we are very comfortable speaking in an academic way to our peers, often with highly specific and accurate yet complex language. This lingo however is rife with technical jargon that can pose a serious barrier to entry for others to join our conversation in a meaningful way. Naturally, the business world has its own unique jargon too. Embarking on a commercial pursuit requires us to enhance our communication skills and have an understanding of your audience and their reasons for listening to you in the first place. Seek out relevant venues to present your deck. A variety of gatherings have already been held during the pandemic (Hackathons, Innovation Centers, etc.) and normally draw potential early stage investors (often called Angel investors). More such events are likely and can be a productive way to have your ideas heard.

It's important to become proficient in explaining your technical work at several layers of detail. Begin with a concise, non-technical, statement of the problem you are committed to solving. Follow this with a basic view of how you will solve the problem. Present how solving this problem will matter to others followed by how that significance will translate into commercial success. End with a summary of your path to success. Based on this solid foundation you can then facilitate deeper technical discourse and nuance. The pitch team (CEO, CSO, and perhaps Founder) should be prepared to go as deep into the details as necessary to answer questions but you should not prepare the deck to do so. Yielding to the desire to fully explain your work is a mistake. Supplementary slides will distract from the presentation. Anything more than the 8-10 slides will be ignored or, even worse, dismissed. Assume the audience has a very clear view of their goals and their rationale for listening to the pitch. The sum total of your pitch should be to encourage an investor to do more work to understand the potential of your effort, in other words, their due diligence. One final note on the format of a pitch deck, too many words on a slide will kill the deck. Make each slide as tightly worded as possible to convey your message. Talking points and not full descriptions are the goal.

One-liners, elevator pitches and one pagers

Often promoted as the networker's friend, one-line summaries, useful during a social encounter, and their longer cousin, the pitch given during the length of a hypothetical elevator ride, are very short summations of what you are doing and can be excellent openings to a longer discussion. The creation of these brief pitch texts can also be very focusing for the entrepreneur. If you cannot describe what you are going to do in a short version, devoid of all detail, are you as focused on the goal as you thought? Will anyone not as steeped in the history, detail and promise of your efforts, ever understand? Conveying your concept, its impact and how serious a contributor you are to the effort can be the first step in a successful funding outcome.

The one-pager request is usually an immediate second step after an effective one-liner or elevator pitch. This document provides a very concise, high level, overview of your business plan and can be seen as the first step in a much more detailed diligence effort.

Investor decks

"The pitch deck argues in favor of the existence of your company…
[while] the investor deck argues in favor of an investment..."

Investor decks take the form of both standalone decks and live presentation decks. These are typically 10-12 slides in length plus additional supporting slides in an appendix. While the messaging and key content is the same, the live deck has the benefit of an oral presenter and so the slides should be more minimally designed so not to overload the audience. As the investor deck is designed to contain more detail for a potential investor, it is a bit larger in scope than the pitch deck. The main argument an investor deck will make is that the team has the proper plan and skills to execute on a commercialization plan and that such a plan has the potential to achieve significant financial returns over a reasonable time frame.

Before creating a deck, it's useful to answer the following clarifying questions

- Should I make a pitch deck or an investor deck for this audience?
- Will this deck be supported by a live presentation or sent as a stand alone?
- Who is your specific audience here and what do they care about?
- What message and impression should they be walking away with?
- What is your story?
- What makes your idea-technology-business exciting?
- What do you need from them (information, contacts, advice, funding, etc.)? Call to action?
- Is there any sensitive information I should not share?

Sample slide flow

Investor decks follow a standard format and require specific content in order to help the investor assess your innovation and your investability. Sections can of course be rearranged and questions moved to different sections but below is a sample flow with core starting questions to get you started.

1. Title slide
    a. Do you have distinct, memorable branding throughout the deck?
    b. Do you want to use a one-liner here to prime your audience on what to expect or build suspense? What will be your communication style?
2. Problem slide
    a. Main message - is this a real, substantial problem?
    b. What is the problem you want to solve?
    c. Why should this audience care? What is the scale and human component?
    d. What is wrong with the status quo, where are the gaps?
3. Solution

   a. Main message - Have you identified the “so what?” and how your technology fills this white space?
   b. What is the underlying technology?
   c. Can you simplify your technology explanation further?
4. Technical data (high level)
   a. Main message - what could convince the audience that your technology works as you claim?
   b. What impressive tech evidence do you have? (curated experimental figures/papers etc)
   c. Who owns the technology - how will you protect your technology, do you have IP?
   d. What are the limitations of the technology? (tentative)
   e. What stage are you at experimentally - is there more to be done? (tentative)
5. Commercial opportunity
   a. Main message - Is this a true innovation (invention+commercialization) or just an invention without business merit?
   b. Why is this attractive commercially?
   c. What is the market size(s) and dynamics?
   d. What is the addressable market? How many people/patients could you help?
6. Competitive landscape
   a. Main message - Who are the key players and what makes you different/superior?
   b. Are there existing players in this space?
   c. Who do you consider to be competitors - who is your closest?
   d. What factors/features/technical capabilities are you comparing against?
   e. What is your Unique Selling Point (USP)?
   f. How do you differentiate?
7. Product market fit
   a. Main message - does your solution really translate into a product that your customers will buy?
   b. Which use case will you target initially?
   c. What type of customer research have you done?
   d. Do you have validation from a third party?
   e. Will you need to educate the market or are they craving your solution?
8. Product pipeline
   a. Main message - what products will you develop and when?
   b. What are your core capabilities and how will your pipeline evolve?
   c. Will you need to scale up?
9. Business plan and strategy
   a. Main message - do you have a viable business model and plan going forward?
   b. What is your business plan?
   c. What is your market entry strategy?
   d. How will you make money - what types of revenue streams?
10. Milestones and funding
   a. Main message - what stage is your business at and what resources will you need?
   b. What technical and non-technical milestones have you achieved and need to in the future?
   c. How much funding do you have to date - how long will it last (runway)?
   d. How much funding do you need to get to each value inflection point?
11. Team (link to more in teams section X,)

a. Main message - Why makes the team investible - do you have the right people to achieve your goals?
b. Do you have a committed team to bring this to life?
c. Do you have the internal competencies and track record to achieve your goals?
d. Do you have partners and affiliations that you can lean on?

12. Ask
    a. Main message - what is your call to action - what do you want from the audience?
    b. Do you want funding? If so, is the amount justified?
    c. Do you want advice or support?
13. Supporting slides for Q+A
    a. What is the work flow for your diagnostic?
    b. Do you have any info on reimbursement? (Can look at CMS website for info)
    c. Do you have any case studies on other diagnostic companies with successful IPOs or exits?
    d. What is your regulatory strategy? EUA?

FUNDING STRATEGY

As you begin to formulate the ways in which to fund your venture, it's important to understand the different types of seed funding that may be at your disposal. Each type has its own advantages and drawbacks and to put bluntly – limitations on access. The following sections outline the main types of funding and key aspects for each.

Angel Investors

Many angel investors have specific prior relationships with the founder or the institution, and could include family, friends, or other individuals in a founder's personal network like a coworker or professor. If you have access to this investor class, it could be a beneficial avenue as they typically require fewer restrictions and terms when compared with venture capital. Another type of angel investor is one that is part of an organized angel fund. These funds can begin to look like private equity or venture capital funds where groups of angels coinvest and they collaborate throughout the funding process. If you do not know any angel investors, we recommend atteding events like Venture Summit and connecting with incubators or accelerators who can help with connections and invitations to networking events. Angel investors can add additional value by mentoring, advising, and even become board members if they are familiar with the technology or market.

What do angel investors expect in return for their investment? Most angel investment deals involve Preferred Stock in the new venture. This preferred stock entitles the investor to equity plus dividends and they will also typically require a liquidation preference. This means that at the time of company sale or liquidation, angels can either convert their preferred stock to common stock and receive a proportional payout or they can choose to take back their capital plus the accrued dividends, at their choice and benefit. Angels may utilize Convertible Debt and SAFEs (simple agreement for future equity). Convertible debt is typically structured such that the investor may choose, at maturity, to either be paid back the principal amount loaned plus interest or convert to equity in the company. There are usually some favorable conditions or covenants that make the equity conversion more beneficial to the investor – said another way, they will get a larger percent equity in the company than the simple conversion would yield based on the current valuation. For SAFEs, investors are simply providing capital in exchange for equity at a later funding round, again typically with favorable terms. The benefit to the founder is that there is no debt obligation to pay the investor back should the venture fail or only reach a low valuation.

Venture Capital

In the healthcare space, venture capital (VC) will be the most probable investor class you will interact with as you start the journey of funding your startup. Venture Capitalists make money two ways: they charge interest on the assets in their funds, and, after the fund investors have been repaid, they capture a share of the returns made by their investments.A specific fund, VC firms may have several running simultaneously, usually lasts 5-10 years. Inherently risky, only 5% of successful investments return 60% of the total returns of the fund. As a result, you must have a clear message as to how a VC investor will see a 10x return on their investment (the ROI) in the next 7-10 years, otherwise you may be deemed too low a return for the inherent risk.

The dollars invested will be accompanied with the described expectation of a return as well as a number of other requirements. This detailed list of items, the term sheet, will include how much of the company they will own based on how much you agree the company is worth; which order any future returns will be paid out; a requirement for their approval of any CEO hire (VC will often place their own candidate at the helm as a condition

of investing); seat(s) on the Board of Directors (or as a Board Observer); and considerations as to how their level of ownership could be maintained as future investors are included.

It is essential that the Founders know how much funding is actually needed to succeed. Too little funding will force potentially high risk or limited decision making constrained by that lack of funding. Too much funding will lead to a loss of control of the decision making as the VC group will have an even greater need for a return on that large investment. Either way, the Founders usually lose their controlling position in the company as investors fund greater portions of the company. While there are exceptions to this, by the time of a successful exit, the founders of a company will often have only 4-5% of their initial position remaining.

Use of Funding Information

Key to the justification of any funding strategy is defining how the funds will be used. At what point will the business generate enough revenue to go from revenue negative (expenditures exceed revenue) to revenue neutral (expenditures equal revenue)? How will the revenue grow from that revenue neutral position to a positive growth rate? Often predicted over a 5-10 year period, this information is your best forecast for a successful investment outcome. This is key for not only determining the potential value of the startup, but to validate how well aligned it is with the overall business model. The sources of revenue depend on the kind of product being commercialized. For diagnostic kits, the revenue will come from kits sales and be affected by manufacturing capacity, distribution, and market adoption. For diagnostic services, the revenue will come from test reimbursement, test volume capacity and market adoption. Having a realistic vision of how your idea fits into the marketplace, and how quickly, is critical to investment decisions.

Grants and Prizes

Grants from governments, not-for-profits, and industry can be helpful to start a new venture with non-dilutive funding. In addition, there may be prizes (e.g., COVID Apollo Innovation Prize) available to help fund a start-up company. SBIR/STTR grants can provide some of the initial funds. In addition, other grants are available specifically for COVID innovation (E.g., RADx). The main challenge with grants is that some have long timelines, which should be taken into account when planning for your business.

Debt

Typically, the least accessible capital source available to founders at the outset is debt. Some ventures can rely on founder's securing Personal Debt, in the form of personal savings, credit cards, and even loans secured by some underlying assets. For the most founders and life sciences ventures, this is not a feasible option. It is also the highest personal risk option for founders. Putting your personal credit at risk or, in the case of a home equity loan, the roof over your head can lead to very poor decision making and significant personal loss.

Valuation

What is a valuation and why is it useful? A valuation is an analysis of the worth (now and in the future) of a given asset or entity, in this case the value of the startup company, and it is useful for determining the percentage ownership of finacial investors. Startup valuation is more art form than science. Most valuations are made using the experience and negotiation skill of the VC firm and the founders. While a number of methods are available, for startups it is common for comparisons to similar companies to be made, forecasts are presented and discussed,

the management team is assessed, the predicted future earnings are analyzed and a determination is made. There is no reliable method to reach a valuation for all situations, your mileage may vary. If the process is so fraught, why do it at all? A fair valuation determines the fair value of the equity of the company. It underpins investment decisions, amounts and expected returns. Understanding the method used in a valuation, the data underlying that valuation and the impact of the final number is important in initial, and subsequent, rounds of financing. Having an experienced, neutral, hand complete a valuation and fully explain the conclusions reached is essential. The initial valuation, before any investment, is termed the Pre-Money Valuation. Follow on Pre-Money valuations are calculated based on a valuation of the company before that follow on investment. Any value of the company following any particular investment is termed the Post-Money Valuation. For example, a pre-money valuation of $1 million prior to investment would change to a post-money valuation of $1.25 million following a $250,000 investment. The investor would own 20% of the company based on that investment (250,000/1,250,000 = 20%)

Equity and Capitalization Tables

Equity in a firm is typically divided into two ownership classes, namely preferred and common stock. At the outset, the founders will be the sole owners of the company, where their total shares equal 100% of the firm. It's important to consider this initial equity split carefully. Most co-founders will opt for an equal initial split out of sheer conflict avoidance. Like many things in life, problems are best handled before they compound, and especially before a lot of money potentially is involved. As a team, consider the following questions. Which founders have added the most value to the project to date? Which founders will add the most value in achieving the established milestones? Which founder has access to the capital and resources needed? If there is a founder who disproportionally adds value or conversely one that will contribute far less, consider allocating the initial equity accordingly. Another factor to think about is vesting equity over time, so that the cap table will change as the company grows and contributions vary. We recommend talking to other academic founders to get a sense of the current thinking.

Any outside investment required by the startup will reduce, or dilute, the founder's share of the startup. Using the above valuation example, by accepting the $250,000 investment, the founders 100% share has been reduced to 80% as a starting point.

Most VC investors will require a dedicated number of shares be allocated to an Options Pool. This option pool is intended to be a reserve set aside for the founders and/or CEO to bring on top management and offer equity states in the venture. Typically, the VC term sheet will specify this to be done "non-dilutive" meaning the option pool shares are provided by the founders, not from the 20% owned by the VC firm.

To keep track of all this, a Capitalization Table – or Cap Table – is used to show the list of owners, ownership stake, and value of the venture and each individual investor. Here is an example of a completed cap table:

Owners	No. Shares	% Owned	Equity Value
Founder 1	1,000,000	5%	$ 750,000
Founder 2	1,000,000	5%	$ 750,000
Series A Investor	3,000,000	15%	$ 2,250,000
Series B Investor	4,000,000	20%	$ 3,000,000
Series C Investor	5,000,000	25%	$ 3,750,000
Series D Investor	6,000,000	30%	$ 4,500,000

Total	20,000,000	100%	$	15,000,000

Cap tables will list each equity holder, the number of shares they own, percent ownership of the firm, and the corresponding equity value. The cap table will start simply when the founders establish the firm, growing in complexity as new investors participate in funding rounds or when equity is given to attract management and key employees to join. Additional information about investments in included in the appendix.

Conclusion

Choosing to commercialize your technology in a NewCo can be both very challenging and rewarding. Many entrepreneurs are very collaborative and willing to help along the way, and finding these individuals through your institution, networking at conferences, or networking on LinkedIn or other social media can be very helpful. In addition, there are several startup incubators and accelerators that create a supportive community for you NewCo.

APPENDIX

AUTHORS

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APPROACH TO RESEARCH

We consulted the expertise within the MGB COVID Innovation Center and interviewed additional experts to supplement our research. *External Primary Research:* Interviews were conducted summer/fall 2020 with the following groups of people: Investors (n=5), entrepreneurs (n=2), Airport executive (n=1), company executive (n=1), US physicians (n=3). In addition, we consulted trade articles, industry reports, scientific publications, and entrepreneurship books. Key references are highlighted below.

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Easy graphic design, icons https://www.canva.com/ (highly recommend)

More Icons https://thenounproject.com/

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SARS-CoV-2 Diagnostics, Performance Data. https://www.finddx.org/covid-19/dx-data/, Sept 2020

ADDITIONAL INFORMATION ON INVESTMENTS

It is helpful to see a simplified example of how funding rounds impact ownership percentages and illustrate how the pre- and post-money valuations fit. Let's walk through an example below:

Round:	Pre-Series A		
Pre-Money Valuation	2,000,000		
Owners	No. Shares	% Owned	Equity Value
Founder 1	1,000,000	50%	1,000,000
Founder 2	1,000,000	50%	1,000,000
Total	2,000,000	100%	2,000,000
Round:	Post-Series A		
Investment	3,000,000		
Owners	No. Shares	% Owned	Equity Value
Founder 1	1,000,000	20%	1,000,000
Founder 2	1,000,000	20%	1,000,000
Series A Investor	3,000,000	60%	3,000,000
Total	5,000,000	100%	5,000,000

The period right before a funding round is referred to as pre-series. The valuation is referred to as pre-money valuation and is what the firm is worth before investors provide capital. This valuation is often negotiated with the investor participating in that particular series – see the previous section on how valuations are assessed.

In this example, we have two founders who have decided to spilt the company equity 50/50 and have allocated 1M shares each. The venture is determined to be worth $2M. Series A Investor would like to make a $3M investment. Taking the $2M pre-money and adding the $3M investment, the firm is now worth $5M. We call this the post-money valuation. The post-money cap table is now worked back from this post-money valuation. First, we determine the Series A investors ownership in the firm. They put up $3M in capital and we just noted that the post-money valuation is $5M. We take that equity value and divide it by the total equity value ($3M/$5M) to get an ownership stake of 60%. Next, the tricky part, we determine the new total number of shares. To do this we take the previous total number of shares between the two founders (2M) divided by their new total ownership of (1-60%). That yields 5M total shares, and we simply subtract the 2M shares the owners retain to get 3M shares for the series A investor. Just keep in mind, the founders own those 1M shares each and will keep them throughout this process. When new investors come aboard, new shares are created, and that previous math is to just determine given the percent ownership and existing outstanding shares how many they need to have in order to

equate with that percent ownership. Finally, we take the founders number of shares, divide that by this new number of shares and to get their new percent ownership. Let's see how this changes over one more funding round:

Round:	Pre-Series B		
Pre-Money Valuation	7,000,000		
Owners	No. Shares	% Owned	Equity Value
Founder 1	1,000,000	20%	1,400,000
Founder 2	1,000,000	20%	1,400,000
Series A Investor	3,000,000	60%	4,200,000
	5,000,000	100%	7,000,000

Round:	Post-Series B		
Investment	5,000,000		
Owners	No. Shares	% Owned	Equity Value
Founder 1	1,000,000	12%	1,400,000
Founder 2	1,000,000	12%	1,400,000
Series A Investor	3,000,000	35%	4,200,000
Series B Investor	3,571,429	42%	5,000,000
	8,571,429	100%	12,000,000

Round:	Pre-Series C		
Pre-Money Valuation	15,000,000		
Owners	No. Shares	% Owned	Equity Value
Founder 1	1,000,000	12%	1,750,000
Founder 2	1,000,000	12%	1,750,000
Series A Investor	3,000,000	35%	5,250,000
Series B Investor	3,571,429	42%	6,250,000
	8,571,429	100%	15,000,000

While you follow the progression, take note of a few important trends. First, when the new pre-money valuation is greater than the post-money valuation of the previous round, that is a result of a reassessment of the firms value. Perhaps the market outlook has improved since the last round, or perhaps you overachieved on some key milestones. Note that the number of shares does not change or percent ownership right before a funding round, but the equity value (what your shares are worth) does change if there is a change in firm valuation.

Next, note that percent ownership after a round of funding is really just centered around the new investor. Whatever they provide in capital divided by the post-money valuation (which remember is the pre-money valuation plus new investment) equals their percent ownership. We back calculate what the number of total shares and shares to the new investor to make that percentage work, then we take the shares from the previous investors and divide by the new total number of shares to see how much ownership has been diluted. This pattern continues each round, so once you understand one iteration, you'll understand the entire series.

The only slight curveball in the math comes when it is decided – or required by an investor in a covenant – to set aside some equity for new hires and bringing on talented management. Typically, this will be non-dilutive to that new investor – in other words, if they new investor says we need to set aside 5% for an option pool, that 5% will be taken from all the previous owners on a pro-rata basis, not out of their ownership stake.

Refer to the provided cap table excel file and following along with the formulas in each cell to get a better understanding where the ownership is moving during each round.

Key Questions to Consider

- Is an equal initial equity split right for our startup?
- How will my equity change during subsequent funding rounds?