Deep Tech Playbook

Getting Your Innovation

From Lab Bench

To Market Launch

Deep Tech Playbook. 2024 v1.1 Edition.

Table of Contents

Introduction

This publication is NOT a book; it's a playbook. What does that mean? It is a short-form, action-oriented manual that provides a powerful guide for anyone wanting to cover the essentials and start moving forward, now, on the launch of a deep tech innovation. There are a number of long-form, hardbound books on the topic of building science-based startups. We can recommend a few. Those are extensive reference guides but challenging to read over a weekend bootcamp (and take up all your backpack space). This playbook can be stepped through easily over a weekend, or day, or even a few hours. You can read it on your phone during those bootcamp breakout sessions.

The Deep Tech Playbook is written for those tasked with moving science-rich (deep tech) innovations from lab to market. You may be:

an inventor and aspiring entrepreneur,
her professor/supervisor/mentor,
a manager of a tech incubator/accelerator,
or tech transfer department,
an instructor of startup entrepreneurship,
or investor in deep tech innovations,

or anyone else interested in the considerations and actions necessary to plan and implement the greatest commercial opportunities for a compelling innovation.

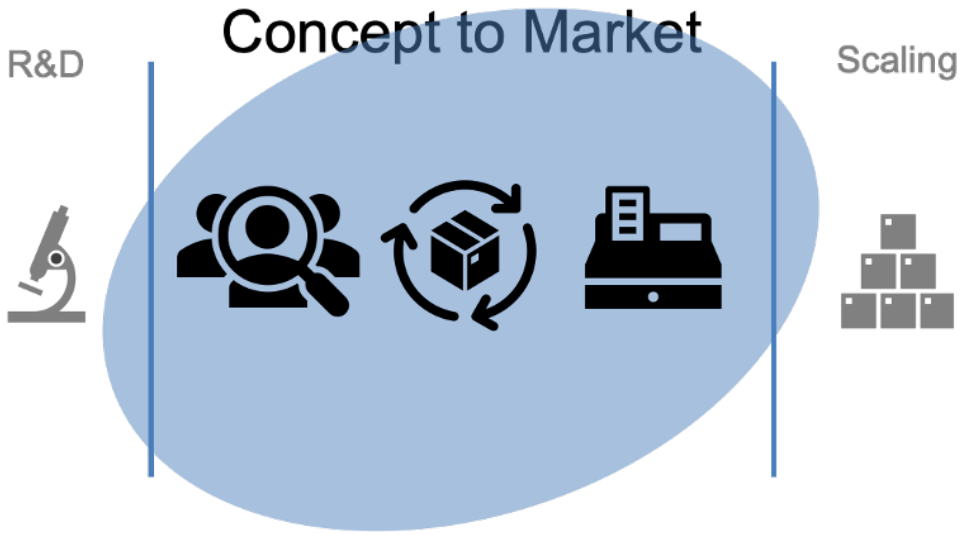
It's the market, stupid.

The foundation to a successful deep tech commercialisation effort is one of market need, not science excellence. The latter is a given (if the innovation merits commercialisation), the former is just a hypothesis at first. There is little commercial interest in amazing solutions looking for problems to solve. Not from the market, not from industrial partners/acquirers, and not from investors. And so we lean into the best practices of customer empathy and product market fit with this playbook, but adapt them for the additional challenges and complexities of deep science development.

The content and breakouts in this playbook focus on that section of project development from *concept proven* (okay, the science works) to *general availability v1.0*. We assume that the innovation's core science has been developed and fundamental limits are known. It works in a controlled lab setting, possibly even providing utility at deep research facilities like CERN or NASA. Now how do you finance and productize it for commercial markets?

We end at market introduction, so also not covered in this playbook is market scaling and the graduation of your startup to a more mature enterprise shipping in volume. The skillset, product and market strategies, and sums and sources of funding required for this latter part of a

commercialisation lifecycle are significantly different than the focus of the Playbook: getting a raw innovation from concept to first commercial customers.



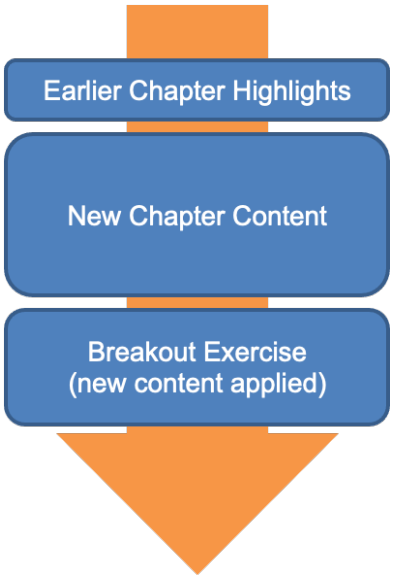
Playbook structure

This book is segmented into 3 sections: Concept; Product; Market.

1. Concept: understanding the deep tech innovation to be commercialized and who would value it most.
    a. Chapter 1: The Science
    b. Chapter 2: Use Case Possibilities
    c. Chapter 3: Value Chain Placement
    d. Chapter 4: Use Case Selection
2. Product: discovering how the innovation should be spec'd – building on step #1 – into a product/service, based on user needs and market dynamics.
    a. Chapter 5: Customer Compassion
    b. Chapter 6: The Market Opportunity
    c. Chapter 7: Competitors and Blue Oceans
    d. Chapter 8: Product Design Optimization and Prototyping.
3. Market: deciding how to graduate from product design – building on step #2 – to market introduction and funding.
    a. Chapter 9: Milestones to Market Launch
    b. Chapter 10: Budgets (to support the milestones)
    c. Chapter 11: Fundraising (to support the budget)

This manual is designed to be followed sequentially, each chapter to the next. The creation of a deep tech commercialisation model, like any business model, is not a predictable, linear process, however. Many assumptions about the market, its customers, their needs, your

product, the competition, and other core model elements will be made and then found weak through validation. This is normal and part of the real-world, constantly-revising, iterative process of business model creation. The redesign practice is never finished. Accept that you'll be taking 2 steps forward and 1 or more back often. But each step will strengthen your knowledge and outlook of success as your understanding of the commercialisation model strengthens. So revisit earlier chapters and reconsider the tangent of your commercialisation strategy as new insights deem necessary.



Each chapter begins with bulleted highlights of previous chapters that should be by that point well understood and applied to your own commercialisation endeavors. The new material being presented will build on this earlier content and continue to drive the commercialisation model forward.

After new content is presented, each chapter ends with a *breakout assignment* to help put this content into practice. It's possible that a dive into new content and assignments reveal flaws in former thinking, which requires a return to previous chapters. As mentioned earlier, you may find this iterative process more the norm than exception.

Suggestions for additional readings and complementary resources are added when appropriate.

Author's confession and readers' agreement

This playbook is based largely on the deep tech venture building courses and workshops that I've been leading for INSEAD for the past 10+ years, mostly with my key collaborator Adrian Johnson. We decided that a booklet stepping through the core concepts and assignments of our program would be helpful to participants, and so I set about writing one in 2023. This initial edition is truly a prototype; one that we fully expect to update and improve on regularly, … with your help. With that in mind, please excuse the typos, grammatical errors, and other oversights.

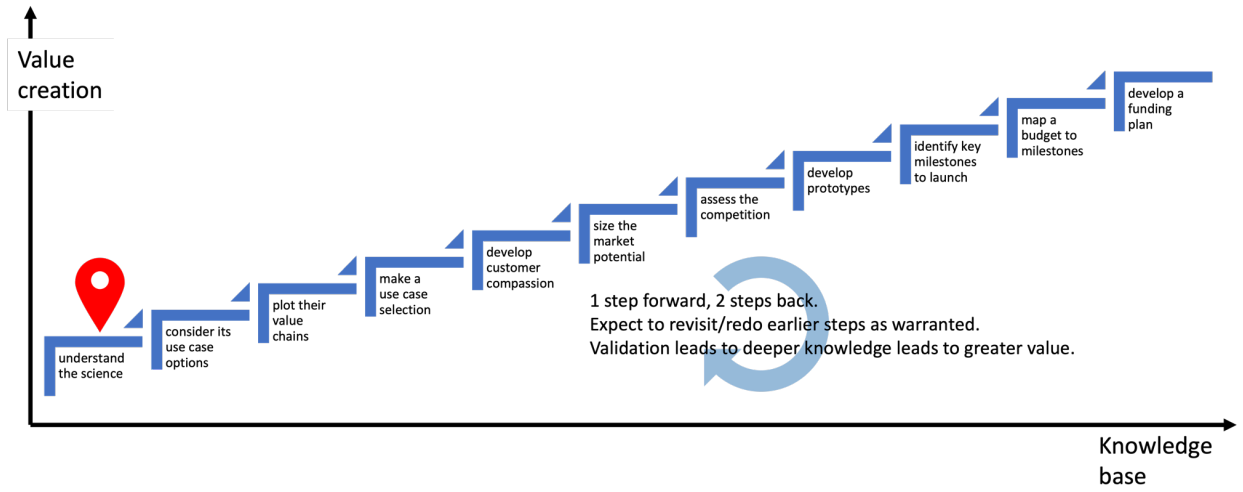
There is no charge for acquiring and using this playbook, but we ask a favor in return. This first edition will be updated as required with the help of you and others interested in contributing to the best practices of bringing a deep science innovation to market. Two things will help us continually improve on the playbook:

1. Let us know which edition you are using (This edition is January, 2024). We would like to track the number of copies in use.
2. Provide feedback about the playbook, principally on what works best and how it can be improved. If there are additional readings on specific topics that you think would be

valuable for readers please let us know. Want to propose a new chapter? Tell us more. We want this playbook to become the definitive reference guide for the process of commercialisation a deep tech innovation. That will only happen with community support. If you're reading this now then you're part of the community.

In both cases and for all other contact I can be reached at bill@interprizegroup.com.

Chapter 1: The Science



Every stakeholder involved in the commercialisation of a deep tech innovation must have a basic grasp of the underlying science. For anyone contributing to the process through management, money, or promotion, this knowledge of what's happening under the hood, even if at just a layman's level, is the fundamental Step 1 to making that contribution.

The science underlying any innovation anchors its value foundation. A basic understanding of its operating principles helps frame the unique strengths that create commercial promise and the limitations that gate its universe of applications. This knowledge forms the base on which the commercialization model will be constructed.

Commercialisation model development without a basic grasp of their underlying operating principles of the science can be an interesting academic exercise, but with questionable value beyond that.

So you're buzzed about a truly disruptive innovation! What do you really know about the underlying science?

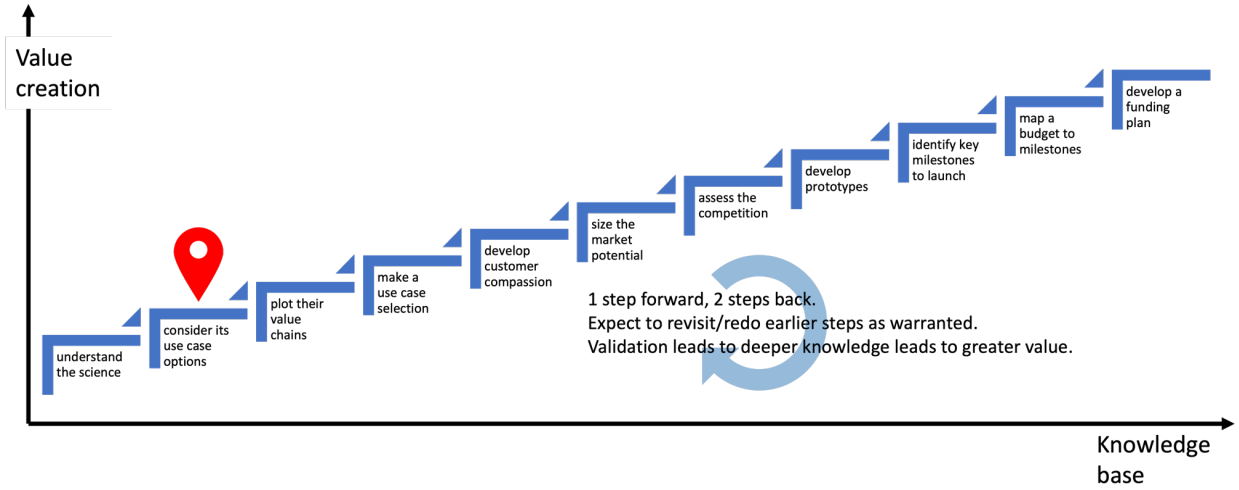
Science Breakout

Answer these questions about the science you hope to commercialize:

- What is it? What does it do (in layman's terms)?
- What are its unique strengths and advantages? What makes it exciting?

- Do these advantages represent an incremental improvement over existing solutions or a radical disruption to the industry? (This distinction will have implications for your market strategy.)
- How might its performance improve in time and what fundamental limits to the science will cap these improvements?
- What is the scientific achievement/breakthrough that enables its strengths and advantages (the thing that can be patented)?
- How might its unique advantages create market value?
- What industries will value this strength/advantage? (You should boil the ocean of possibilities at this early stage.)

Chapter 2: Use Case Options (Evaluating all case possibilities)



To start this chapter you should:

- Have a solid understanding of the underlying science.

The optimal commercialization strategy for each science innovation is unique, a function of its many differentiating science, product, and market factors, all covered in this playbook. The bookends to these factors include the source science and end uses to which it provides the greatest market value.

The use cases will determine if the market strategy is B2C, B2B, some hybrid of both, or another open innovation approach. The use case will determine if the product implementation is an IP license, component, module, subsystem, full hardware/software/service platform, or something else along the value chain. It will determine your channels and partners and competition.

It's essential to start narrowing down on the best use cases early when plotting the commercialization strategy and design to those applications. It's essential to NOT commit to a product concept BEFORE understanding the best use cases. This is a recipe for much needlessly wasted money and time.

Unless you have the luxury of unlimited resources – capital, people, and time – you'll want to identify the one single most promising option around which to create a commercialization model. This chapter helps build momentum in that direction. In the course of framing a business model you may realize that those assumptions about the opportunity that had you most excited are

wrong. That's okay. You can pivot as necessary, and you'll be gaining a better understanding of your business model as you advance.

So, what is your use case of greatest promise? If not immediately certain, then start with the big picture and focus in. Start with WHY this innovation merits investment, not exactly WHAT will be developed. Create a *Mission Statement* that reflects the greatest purpose the commercialization of this innovation can provide for its users and other beneficiaries. How might it change the world? For whom? This statement will serve as the north star for your strategy and execution through time.

Don't confuse the Mission Statement with your Value Proposition. The former spells out the broad vision. The latter frames how that vision will create value. Here are 3 examples of well-crafted Mission Statements. In all cases the mission is clear, inspiring, and impactful.

To bring the best user experience to customers through innovative hardware, software, and services.

To accelerate the world's transition to sustainable energy.

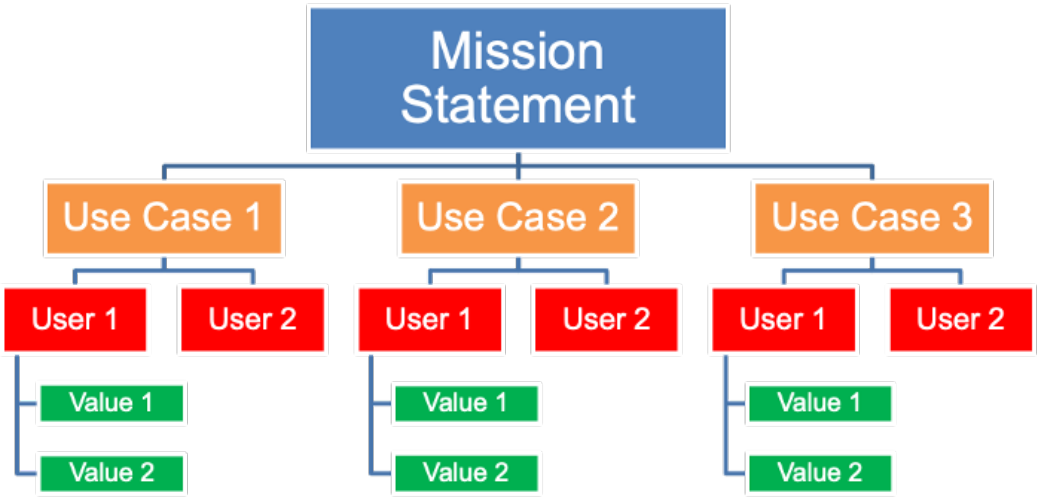
To ensure that artificial general intelligence benefits all of humanity.

Once you are confident with your Mission Statement, list what you know (at this point):

- In what use cases (there may be many) will your innovation be applied?
- Who stands to benefit the most from each use case?
- What value/benefits does your innovation bring to them: Costs, performance, size, efficiency, time-to-market, and other factors can be key to this evaluation.

In all instances is alignment with the Mission Statement tight? If not, does the Mission Statement need to be revisited?

These exercises will move you closer to understand the use cases most promising for your innovation.



Use Case Breakout

Draft a Mission Statement that reveals the greatest market ambition driving the commercialization of your science innovation. Who will benefit? How will they benefit?

Now narrow down. Given this Mission Statement, list up to 3 promising use cases for your innovation. You may know only one. You may know a dozen. Start with 1-3 for manageability. For each, identify:

- The application in which your innovation will be applied.
- The user whose activity benefits from this application. Maybe it's an auto designer, or the driver, or the mechanic who services the car. Think about your industry. Give them a user label.
- Their job or activity that involves your innovation.
- The benefits and value that your innovation brings to this job or activity.

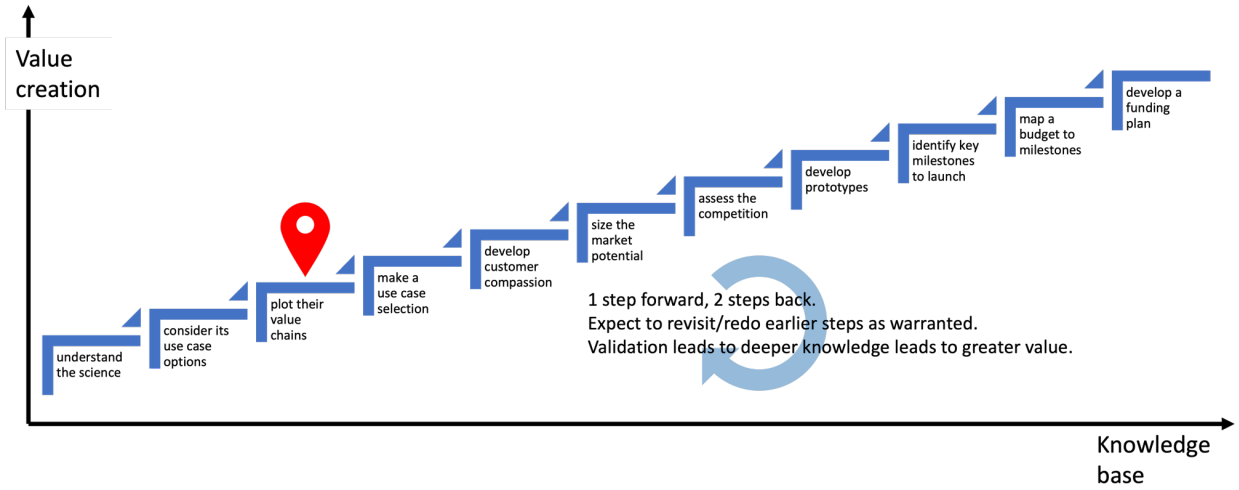
For each use case can you identify:

1. Pains or challenges they encounter while doing their job or activity that can be eliminated or lessened by your innovation?
2. Gains or improvements enabled by your innovation that would make their job or activity either easier, less expensive, more precise, or support some other positive outcome.

Additional reading:

There is an endless list of well-written articles on crafting powerful mission and vision statements online. For one that we like from WeAreBrain click here.

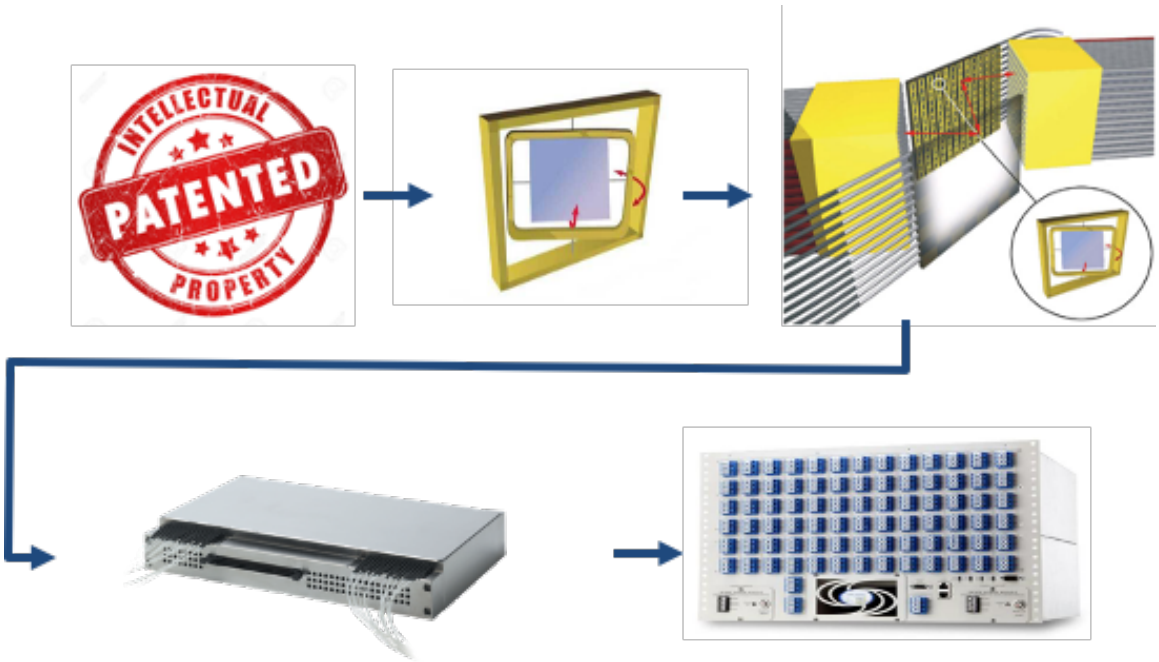
Chapter 3: Value Chain Placement



To start this chapter you should:

- Have a solid understanding of the core science underlying the innovation to be commercialized.
- Have identified up to 3 compelling use cases for its application.

This chapter is not about setting product features, specs, and other design considerations. It is about something more fundamental that will guide those considerations: the placement of your innovation in the value chain of your industry. You have compelling deep tech IP. Should it be simply licensed, or does it merit an investment in productization? If the latter, should that product be a material, component, module, subsystem assembly, full system with control software, or something else?



An optical switch value chain: IP, component, module, subsystem, and full system. (Based on Calient's 3D MEMS innovation.)

It is critical to think about value chain placement early in the commercialization process; before you've invested significant time and money in developing a prototype or product. There are two different approaches to finding your place in the industry value chain:

1. Optimizing the return on productization investment. With this approach you control the placement decision.
2. Optimizing on customer and market need. With this approach your customers and the market sway the decision, even if suboptimal from an ROI analysis.

From a purely financial perspective you want pursue Option #1. A straight-forward ROI analysis will determine your optimum placement in the value chain based on a comparison of the discounted cash flows from each product form and the investment capital required to support these cash flow over time. Cash flow generated by an IP licensing strategy will be much less than from selling full systems, but the capital required to support a licensing model will be orders of magnitude less as well. The ROI may be higher.

From a practical perspective you will likely pursue Option #2. For your customers the desired product option may be in a form factor other than that for your maximum ROI. The end user may be uncomfortable buying a full system from a startup. (Will you still be in business in 10 years to service it?) They may prefer that you supply components or subsystems to an established and trusted full system manufacturer, who then assembles, sells, and services the final product. In another example that defies ROI optimization, you may be required to develop control algorithms or evaluation kits for customer testing of assemblies or systems pre-orders, even though these are expenses that won't be recuperated.

Another market consideration is timing. To accelerate the adoption of your innovation you may have to move up the value chain. No one will be eager to license your IP or source your component if there isn't a clear and established path to adoption in the existing industry. Referring to the diagram above, imagine that you have novel 3D actuated MEMS mirror IP optimized for optical communication networks, but no one in the industry has yet developed a full optical switching system. You can wait for an established systems manufacturer to do that and be its MEMS mirror supplier, or with sufficient resources you could design and build the entire system yourself. The latter option will be expensive but may be the quickest route to market, which will affect your ROI analysis.

If you have the option to bring your innovation to market at different locations along the value chain then an ROI analysis, even a simple calculation based on imperfect information, should be conducted. Ultimately, however, a successful market placement will likely be dictated by the existing industry supply chain structure and your customers' expectations. How do you know your customers' expectations? Ask them.

Before investing significant resources in prototypes approximating commercial form factors, first understand how you prefer to productize your science (based on an ROI estimate) and how the market prefers you productize your science (based on select validation discussions.). In a beautiful world it will be the same.

From chapters 1 and 2 you should already understand the science and its disruptive strengths and innovations, plus the most likely use cases. Now, identify your most attractive customer targets by industry, company, and title. There might be 100 target individuals, or there may be 10 or fewer. Whom can you contact to introduce your innovation and confirm your assumptions and preferences on how its value can be best leveraged in the market?

Consistent with the core tenants of The Lean Startup Methodology, it's critical to validate your assumptions on how and where your innovation will find its place in the market before committing considerable resources to that commercialization effort.

Value Chain Breakout

Based on your core disruption and set of use cases, sketch the value chain – from core IP to end retail sale – of each product market you plan to enter. Your insertion points along each chain will likely be bounded by a pure IP licensing option at one end and a complete system/platform productization at the other.

Based on an ROI analysis and other resource considerations (limiting constraints or enabling assets) where would prefer to insert your innovation into the value chain?

Whom can you talk with to explain your innovation and share your commercialization model assumptions, as they exist at this early point, for feedback? This may include others directly behind you on the chain (your suppliers) and those in front (your customers).

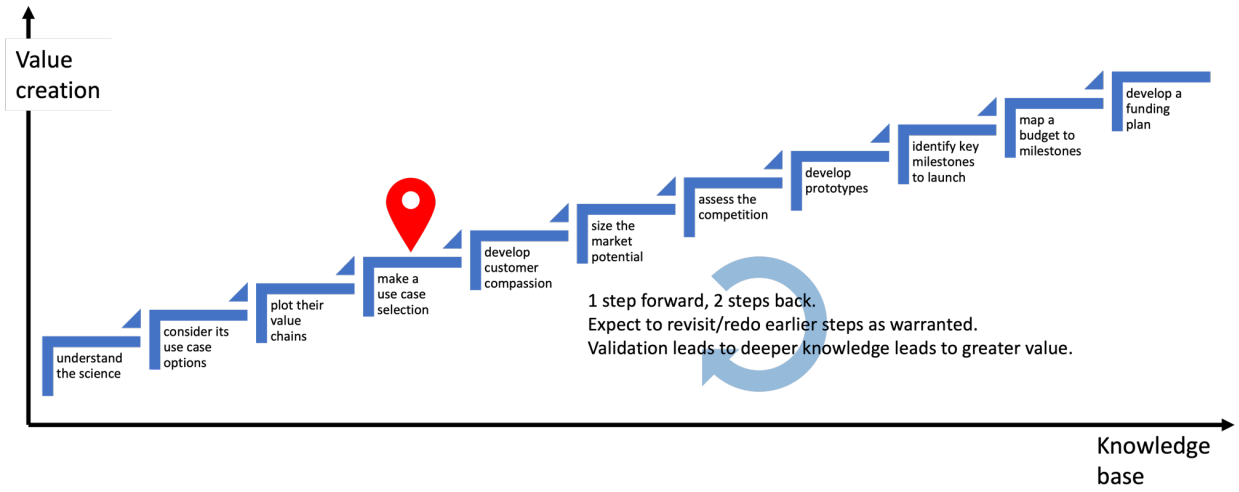
Through these discussions confirm (or refute) that they:

- Understand and value your deep tech disruption.
- Would in theory be interested in supplying to or sourcing from your organization selling this innovation in this product format.

Also determine what considerations and requirements other than price would affect their decisions to be suppliers or customers. These could be technical or financial.

Based on the feedback from these early discussions reevaluate your position in the industry value chain.

Chapter 4: Use Case Selection (Settling on 1 case)



To start this chapter you should:

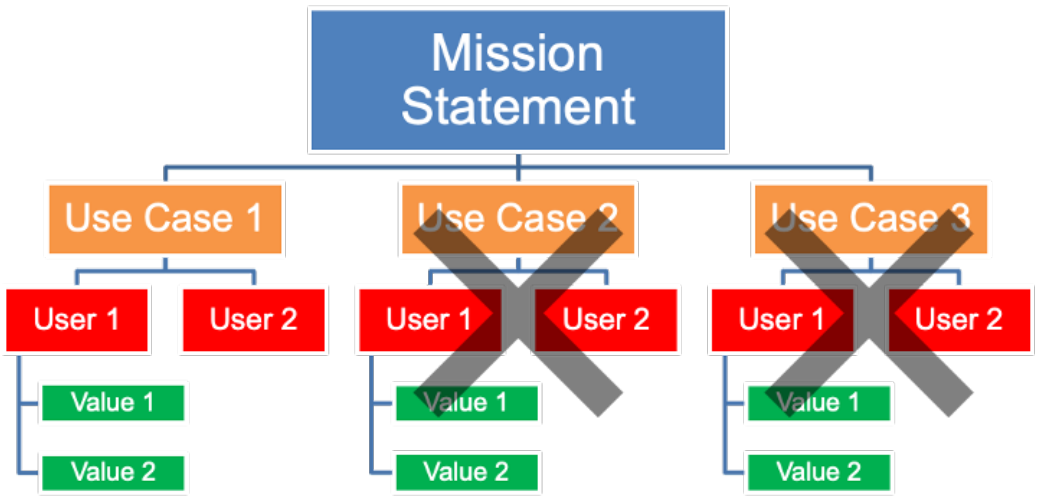
- Have a solid understanding of the core science underlying the innovation to be commercialized.
- Have identified up to 3 compelling use cases for its application.
- For each use case have determined your optimum placement in the industry value chain.
- Based on value chain placements, have determined how your innovation would be most effectively productized (in broad terms), and validated these assumptions with select, targeted interviews.

You'll want to rank options and then select the one single use case to pursue if you're a startup operating on limited resources. Some innovations offer real value in different applications and industries, but pursuing them all requires too much capital in money, manpower, and time for most startups to manage.

As an example, consider a novel silicon material that significantly enhances efficiency (higher speed or lower power) and enables the growth of non-silicon semiconductor materials directly onto the silicon substrate, without lattice defects. Chips made from this material could be of great value in standard semiconductor end markets like computers and cell phones, where speed and power are critical performance differentiators. They could also be used to create low-cost integrated optical switching elements on silicon for communications markets. And a third application space could be in photovoltaics, where efficiency improvements by just a few percent creates immense competitive advantage. (This could describe Amberwave, a 2000 MIT spinout led by Professor Eugene Fitzgerald.)

A startup may be tempted to pursue all 3 use cases given the large market potential of each. It's unlikely that sufficient capital could be raised for such an ambitious strategy, and an organization of this breadth could be effectively manned and managed by a small startup team. It is an imperative to recognize these commercialization opportunities and rank them according to the outline in the previous chapter. What are the ROI and other determining factors, such as time to market, competitive leverage, ability to staff, and supplier and customer preferences for each? Then select the single use case to pursue first and execute.

Note that the use cases ranking lower than #1 on your priority list can still be monetized through other avenues. Perhaps a spinout can be created or licensing to a larger corporate entity arranged. Open Innovation, an approach popularized by Henry Chesbrough of the University of California, Berkeley, encourages organizations small and large to think about nontraditional strategies for commercializing compelling innovations beyond just an IP license or *build it ourselves*. The options are many.



Once your #1 use case is selected it is critical to run a rough sanity check on the resources required for your innovation's commercialization to that target application. Some of the data required for this analysis may have been gathered for the previous chapter. With regards to moving your science to the commercial market, identify:

- The time required to move the innovation to commercial availability (science innovations often require years of development and testing).
- Major capital equipment needed.
- Critical headcount and profiles required to finish R&D and separately build product design, engineering, and business development/sales teams.

Don’t waste time at this point fine tuning a monthly or quarterly budget. You may not have sufficient data and it’s not yet a priority. But you need to make at least rough estimates of the time, manpower, and funding needs to confirm, or not, that the use case you’ve prioritized as the most attractive is indeed realistic to pursue.

Use Case Selection Breakout

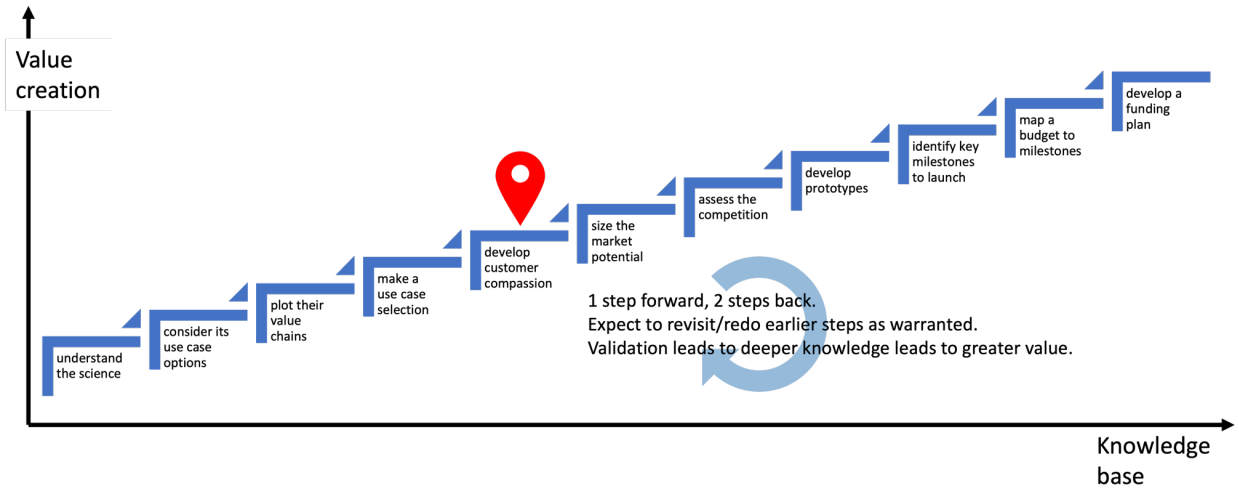
Rank the possible use cases for your innovation and select the single most attractive opportunity. To determine the ranking order generate rough estimates of:

- The ROI
- Time to market
- Capital equipment requirements
- Manpower needs
- Funds required to get to market

Given the results of this analysis the commercialization team needs to accept, or not, that this option warrants pursuit.

If yes, congratulations, you are ready to continue with the productization of your innovation. If no, redo this chapter on the second most appealing use case you have identified.

Chapter 5: Customer Compassion



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- For each use case determined your optimum placement in the industry value chain.
- Have determined how your innovation should be most effectively productized for each use case placement, and validated your assumptions underpinning these productizations with select, targeted interviews.
- Identified the single most attractive use case and agreed amongst the team that it warrants pursuit.

Compassion: *Sympathetic consciousness of others' distress* (i.e., empathy) *together with a desire to alleviate it.*
Merriam-Websters Dictionary

On Empathy

Capturing *customer empathy* (through *customer discovery*) has risen to the apex of critical deliverables in most workshops, courses, and publications on business model development. It resides at the core of the lean-inspired startup methodologies mentioned earlier, and for good reason. Before significant sums of capital are invested (and likely wasted) in product development it is essential to understand the customers' needs, pains, limitations, and other factors that help you maximize value through product design and a go-to-market strategy.

But capturing empathy is just a means to an end. It must be applied through smart product design and support to offer compassion and create value (for both your customers and your organization). A customer compassion program involves 2 steps:

1. Gaining empathy for your customers' pains, needs, and desires.
2. Developing a product and support plan to amplify their gains and alleviate their pains.

Deep tech innovations are most always developed with a specific function to achieve, or challenge to address. To measure, or modulate, or parse, or drill, or filter, or convert, or sense, and do these things in a way that improves upon earlier approaches. There are real user pains being resolved, real gains being sought. So, developing empathy is relatively straightforward, as opposed to the many *look-alike* innovations with questionable utility seen in the app space (but we digress).

How do you heighten customer empathy? Primary research through interviews (and surveys) is the most effective and insightful approach. When the innovation is an app or other consumer product – particularly a digital innovation – then this is simple to organize. Online resources are plentiful. Existing surveys can be accessed. Potential users number in the millions. Deep tech is different.

Science-rich industries tend to be concentrated and the end users more complicated to contact. You won't likely have millions of customer targets. You may have dozens; you may have fewer. Telecoms, pharma, energy, space and aeronautics, semiconductors: these are just a few examples of concentrated industries where large mega players dominate.

Building empathy for your customer(s) - whether you have just 1 or 1 million - starts with a solid understanding of how they conduct their jobs. What are they doing, precisely, that involves your innovation? Building rocket engines, analyzing data, modulating a laser over fiber optics or free space, …? What challenges and limitations are they suffering? What are the achievements and rewards they are seeking to gain? Note that not all considerations are performance or financial based. Some may involve emotional, social, or other non-obvious pains and gains.

Adapted from the Value Proposition Canvas, Strategyzer

Empathy to Compassion

Once a foundation of understanding and empathy for your customers' challenges takes shape, then a customer compassion plan for expressing this empathy through product design and related support can be created.

Your science disruption may be a high-efficiency battery chemistry that recharges rapidly in a small, light form factor. An exciting scientific breakthrough. The customer - perhaps a power utility - values this distinction, and through a few select interviews you understand that it needs to deploy such solutions to remote locations with short notice, and with various scalable power capacities. By designing rackable, stackable, portable units pre-installed in truck trailers you are showing customer compassion. Your science disruption is in battery chemistries, but your productization, in this example, involves a much greater platform solution.

Compassion to the Value Proposition

It is also the moment to draft a *value proposition* that reveals the users' pains and how your science solution resolves them, not only effectively but without equal. This concise statement forms the foundation of that *elevator pitch* you can deliver, often unexpectedly, to any type of stakeholder in your commercialisation success: an investor, potential new key hire, startup competition judge, or other. It will need to be tattooed to the back of your head, as the saying goes, so you can deliver it by muscle memory, even when flustered to find yourself in an elevator with the most respected investor in your technology sector.

There are no hard and fast rules for crafting strong value propositions. They need to amplify the promise of the innovation, succinctly, impressively, but without superfluous flourish. Value

propositions must be irresistible, irrefutable, and easily digestible. That final requirement can be a major challenge for deep innovations built on an exotic sciences.

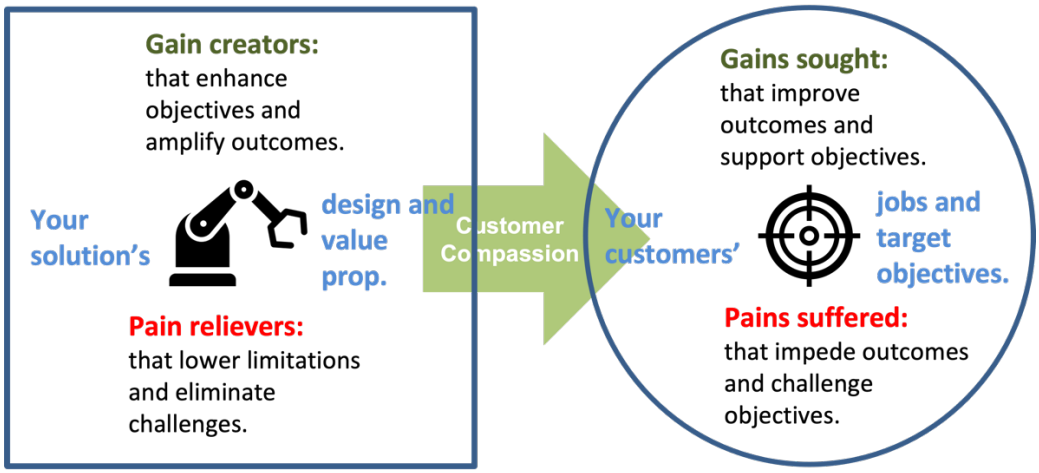
If struggling to create a strong, clear value proposition consider using a *positioning statement*; essentially a template for expressing the distinct and competitive value of one's product or service. Note that like most all effective value propositions, it starts with the pain being resolved, not the solution itself. No one cares about your impossibly narrow laser linewidth or high battery efficiency if they can't first understand why that matters.

Positioning statement template:

For (target user)
Who (statement of need, related to the pains/gains above)
Our (technology) is a (technology category)
That (statement of benefit, that resolves the pains or amplifies the gains)

Unlike (competitive technology alternatives)
Our approach (statement of primary differentiation)

Regular and repeated communications of your assumptions about user needs and how you address them is required with favored customers, or those with whom you hope to be first customers. Concepts and early prototypes are the best form of customer collaboration and communication. More on that in the next chapter.



Adapted from the Value Proposition Canvas, Strategyzer

Customer Compassion Breakout

For the identified customer of your favored use case, answer these questions (to the best of your existing knowledge):

- What are they trying to accomplish (that is relevant to your innovation)?
- What challenges complicate meeting these goals?
- What are they doing now to solve these challenges?
- How can your solution do a better job of helping them overcome these challenges?
- Write a powerful value proposition for your targeted user. (Use the position statement template if helpful.) Can you deliver it in less than 30 seconds?
- Create an elevator pitch about your effort, including the solution's proposed value, but also the skilled team, large market size and defensible market dynamic, and anything else that sets the hook. (We'll work on perfecting this in the chapter on fundraising.)

You will not have solid, validated insights to all these questions. For those that you do, list your knowledge and assumptions. For those that you do not, list what you (think you) need to learn.

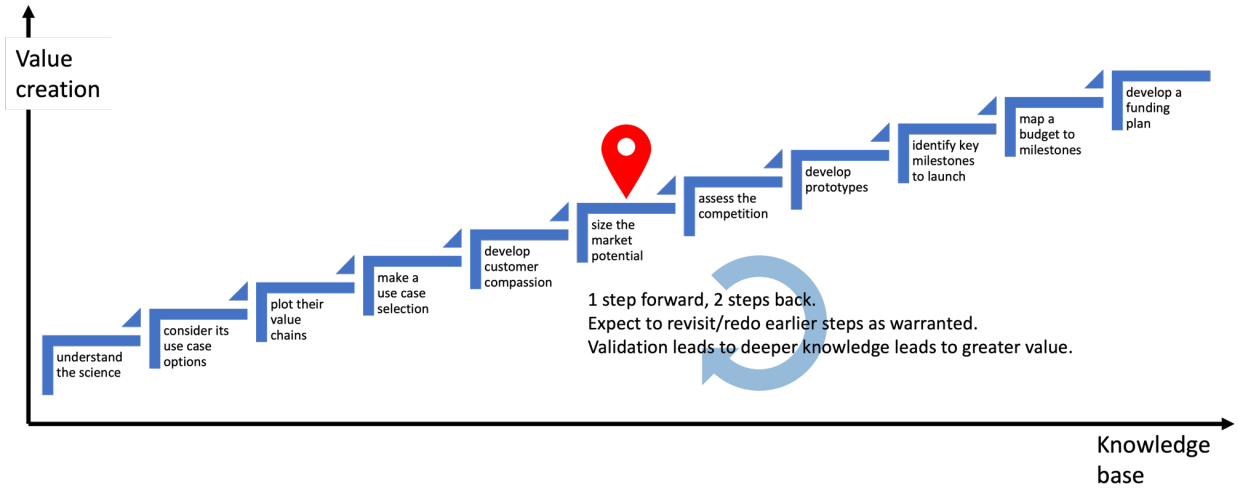
Create a questionnaire of pass/fail questions to validate your assumptions and gain a better understanding of the unknowns. With whom can you start to validate your customer compassion strategy? Refer to Strategyzer (link below) for helpful tips and tools for validation testing.

Additional reading:

The Value Proposition Canvas. Strategizer.

Resources for validating assumptions. Strategyzer. Click here.

Chapter 6: The Market Opportunity



To start this chapter you should:

- Have a solid understanding of the core science underlying the innovation to be commercialized.
- Have identified up to 3 compelling use cases for its application.
- For each use case determined your optimum placement in the industry value chain.
- Have determined how your innovation should be most effectively productized for each use case placement, and validated your assumptions underpinning these productizations with select, targeted interviews.
- Identified the single most attractive use case and agreed amongst the team that it warrants pursuit.
- Created a customer compassion strategy centered on a profile of (1) your targeted user's jobs, (2) the needs, pains, and desired gains related to these jobs, and (3) the steps you can take to resolve them.

Sizing your market opportunity – realistically and based on rigorous analysis – is critical to most every element of the commercialisation model.

What markets should I pursue?
Well, how big are they?

I have various markets that require different product features; how should I prioritize the development staging?
Well, how big is each market now and how will that change in time?

How much money should I raise?

Well, how much of your market(s) can you capture and convert to positive cash flow, and when?

Does this innovation even warrant commercialization?
Well, how big is the market opportunity and how much can you capture?

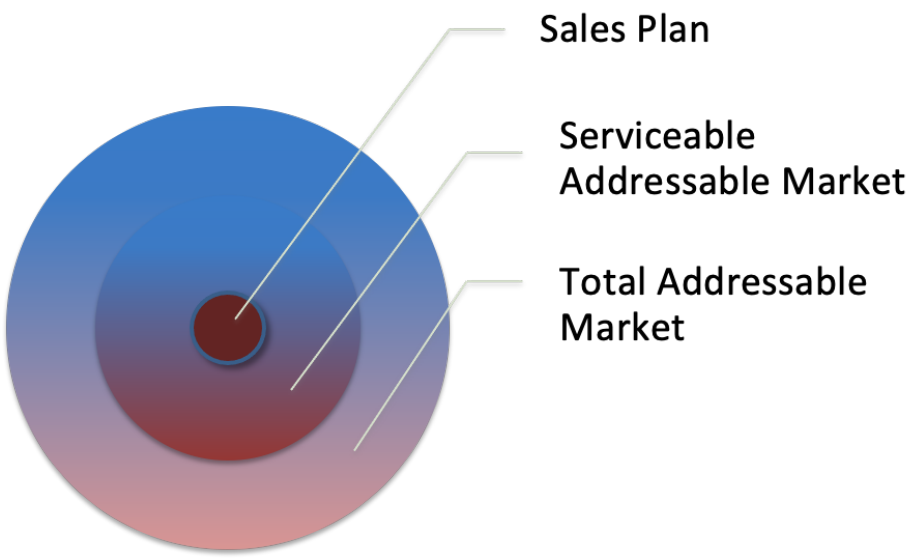
In business school speak we have TAMs, SAMs, SOMs, PMs, and other acronyms to define market size parameters. It's good to have a common lexicon to which everyone agrees. The challenge is in finding agreement on just what EXACTLY is the definition of this or that xOM.

To simplify definitions consider these 3 market estimates. You should be able to define these, at a minimum, and share them clearly with others:

1. The total market opportunity pursuable with unlimited resources in capital and time. We'll call this the Total Available Market (TAM).
2. The realistic market opportunity pursuable now or in a clearly defined time point, with the current business model and product(s) available or in development. We'll call this the Serviceable Addressable Market (SAM).
3. Your sales forecast. This is the part of the SAM that you expect to capture as revenue at a set of clearly defined time points. We'll call this your Sales Plan.

Your market estimates will also need time vectors: this is my SAM now or Sales Plan in Year 3. Larger market estimates depend on a variety of factors, including the maturing of your market. The TAM of an emerging innovation at the beginning stages of its Hype Cycle will be tiny compared to a few years out when adoption starts to peak. Every estimate needs to be defined with time.

Every major stakeholder in your commercialization effort will want estimates of the market sizes. Some will ask you to provide them, some will create the estimates themselves. In the latter case you'll want to sanity check these against your own assessments.



TAM

The TAM is your blue sky, unconstrained but credible, long-term market opportunity. It is often presented by aspiring entrepreneurs as their “market opportunity” because it is the most impressive. It can also be the most deceiving. Your major stakeholders – investors, acquirers, key hires, and others – will indeed want to know the total market opportunity you can pursue with unlimited human and financial capital, and over a long period of time. But they won’t assume you can pursue that entire opportunity now. (And that’s why you also need estimates of your SAM and Plan).

Let’s consider investor interest in your TAM. Venture capitalists are most attracted to startups with the potential to grow into billion-dollar opportunities valuation-wise. This requires major scaling over the long term. Given the large amounts of capital required to bring most deep tech innovations to market no single investor will be providing all the funding to support that growth strategy, but he will (he hopes) still be a shareholder when an exit occurs and your potential is rewarded. If you want to get investors excited about your innovation you need a large, credible TAM that you can scale sales into with all the resources their capital, and that from others, will enable.

Credible is the key word in the earlier paragraph. As mentioned, the TAM should represent the entire market available to your innovation void of resource constraints. It cannot, however, include markets closed to your innovation, even in a world of unrestrained assets. Russia and Iran are 2 countries on most western nations’ list of trade sanctions as of this writing (November 2023), and technology sales or partnerships with Chinese military implications are strictly forbidden. These are just 3 examples of likely limitations to your TAM.

SAM

As with your TAM, any pending stakeholder – investor, pending employee, or industrial partner, as examples – in your commercialization effort will want to know the size of the markets you can pursue in the near term with the Gen 1 product under development: your SAM. A VP of Sales will be compensated largely on sales targets and her ability to beat them. What market opportunity serviceable now is reasonable for her to pursue? A partner will want to understand the size of the markets your innovation can help them open up now.

Continuing with the investor example, a venture capitalist will want to know what his funds in the current investment round might achieve. How far forward it will advance the commercialization process. Perhaps it will get the prototype finished or the Gen 1 product to market; perhaps not. But the size of the market this innovation will encounter now (or when released) is a critical part of his diligence and decision – *do I invest or not* – process. How big is the opportunity that you can pursue with the capital in hand or plan to raise in the near term? This is your SAM.

Sales Plan

The Sales Plan is the top line of your cash flow statement, discussed more deeply in Chapter 10. It includes the revenues you forecast from product sales, licensing fees and royalties, engineering support fees, and all sources of sales and services related income. It will be that slice of the SAM that you plan to capture plus related fees, quarter by quarter, for at least 3 years from now.

Your investors will expect a defensible estimate of sales, even if you don't yet have a clear sense of your larger budget. It reflects the progress of your product commercialization effort, when you expect to generate first revenues, and how quickly they might grow. You may not expect product sales for the next 3 years (although fees could start sooner). Identify when you believe that revenues will start and project 3 years out from then.

A note on modeling sales

Deep tech product and customer development requires more time than typical digital innovations, particularly for emerging, disruptive technologies. Will the product work in the field? Will all the products work to spec when produced in quantity? Will it still be working to spec 3 years, 5 years, and 10 years from now? How seamlessly will it work with entrenched platforms? Will the company manufacturing it - perhaps your startup - still be in operation in 10 years to service it? These are just a few questions adopters of new technologies ask themselves before placing commercial scale orders. Be aware of these and other customer hesitations and put a plan in place to reduce their impact on sales growth before forecasting a rapid scale up in orders.

Refer to Chapter 10 for a deeper discussion of revenues and Sales Plan.

The TAM, SAM, and Sales Plan weave together to reflect a credible effort at understanding the opportunity to create value from your innovation, both in the long term and more immediately. The Sales Plan will be a percentage of your SAM, which will be a percentage of your TAM. And these percentages will shift over time as product penetration into your markets is expected to grow. If you cannot credibly forecast sufficient growth into your markets to excite investors or industrial partners, then it is a good moment to question the viability of your deep tech commercialisation effort.

Adoption Timing

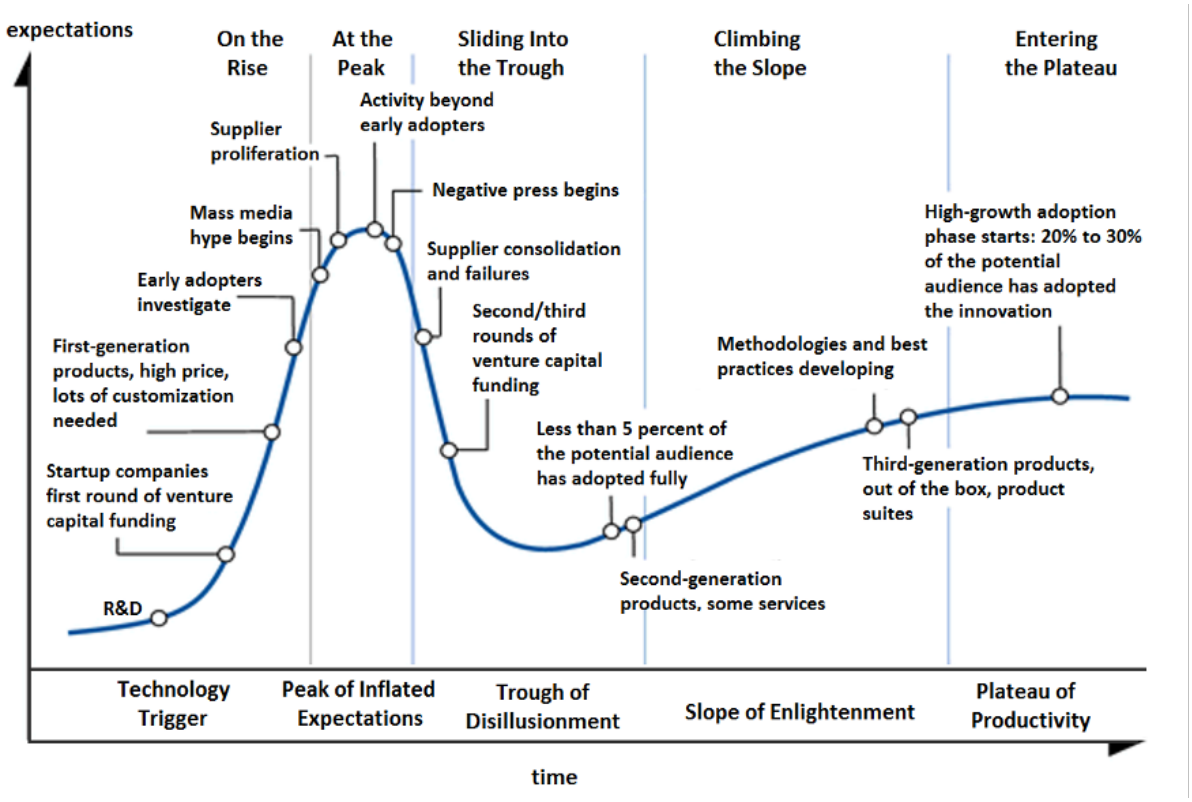
Getting a deep tech innovation from *light-bulb moment* to first customers can take years, decades even. You may push up against fundamental limits. You may struggle to buy commercial equipment for testing and measurement. You may need to progress through multiple time- and cost-consuming phases of regulatory certification. It will likely take longer

than projected to get it working as a commercial product, meeting performance promises repeatedly and reliably. And perhaps most frustratingly, your global target customer base – who collectively comprise your TAM – may lose confidence in the grand technology promise just when you have overcome productization hurdles, as mentioned earlier. The dream of all-optical networking, which hyped a massive market bubble in the late 1990s, is just 1 example.

The Hype Cycle, originated by the Gartner Group, is a convenient tool for considering the dynamics of deep tech adoption when sizing your markets. With the curve, Gartner suggests that most, if not all, new technologies travel along a curve of expectations and adoption marked by a peak of early exuberance, then a trough of mid-term caution and disappointment, and finally (if the technology is still relevant) a long-term plateau of market embrace. The shape and duration of any single technology curve has much to do with working out the bugs and convincing users that the technology is sound and reliable.

There are endless articles online about the Hype Cycle and how to use it. Indeed, Gartner produces dozens of technology-specific curves annually. This diagram by Olga Tarkovskiy provides a clear definition of major points along the curve. Where does your science innovation reside and what does that mean for your market sizing projections?

Gartner Hype Cycle, Adapted by Olga Tarkovskiy



Gartner Hype Cycle, Adapted by Olga Tarkovskiy

Sources of Market Intelligence

Stakeholders will expect estimates of the markets you are pursuing and your sales forecasts may well be driven off of them. So where do you get them? This is one of the biggest challenges encountered by entrepreneurs when building credible deep tech commercialisation strategies. Finding intelligence on established technology markets - semiconductor wafers, fiber optics cable, industrial robots, military drones - is relatively straightforward. Estimates of emerging technologies - generative AI, open telemetry, solid-state batteries - are much harder to find. Indeed they may not yet exist.

Market intelligence comes in 2 forms: primary research (DIY) and secondary research (someone else produces it).

Primary market research:

The only option available to sizing your targeted market may be through calls, visits, and estimates done by you. For newly-emergent innovations secondary market research reports may simply not yet have been produced.

The upside to the DIY approach is the control you have over the parameters of the forecasts and your feel for their level of accuracy. Because you're conducting the research (or paying someone to do it) you can drill down into any level of product category granularity - your exact position on your industry's value chain (Chapter 3) - and ask targeted questions that will best unearth the data you seek.

The downside is time, money, and forecasting expertise. Off-the-shelf studies offer immediate estimates that were arrived at by well-trained and experienced analysts (hopefully), but they are expensive. If you retain a professional market analyst you may pay even more, but the research will be targeted and professionally conducted. It will, however, take time (think months).

Fortunately we now have AI, and it can aid the task of conjuring reasonable estimates based on grounded assumptions and recognized unknowns. Forecasts derived through AI and general internet searching may indeed be much less perfect than a bespoke research study (as of this writing in November 2023), but also less expensive (free) and immediate.

Secondary market research:

Secondary market research is available in 2 forms:

1. Estimates produced for purchase by market research firms and private analysts. Gartner, Forrester, and IDC are 3 of the larger firms creating general and customized research for high-tech markets. Dozens more exist. Private analysts skilled in the art of data collection and market forecasting are available as well to produce analysis - sizing, growth, and market shares - in various deep tech domains. Many analysts learned the craft while working for larger market research organizations.

Market studies from this source will be priced in the thousands or tens-of-thousands of dollars typically, although one could expect that AI-generated analysis will put downward pressure on prices. Free data can sometimes be found in the overview of findings, which are often available online to promote the research. An AI or Google search might reveal enough data to enable a start on estimates by you with “reasonable” confidence.

2. Estimates produced ancillary to other services from sources such as investment banks, management consulting firms, and online newsletters/podcasts can provide some of the best estimates for no charge. These groups create a lot of content for their clients for free. Getting access to it can sometimes be a challenge, but *horse-trading* is worth a try.

   All of these architects of market analysis and forecasts mentioned above - market researchers, equity market analysts, management consultants, producers of online content, and others - are looking for unique knowledge and insights on emerging markets that their competitors don’t possess. Information on a core science (“explain to me one more time how blockchain really works?”), which universities or large industrial corporations are doing the most compelling research in this space, the challenges innovators are struggling with moving the innovation from lab to prototype to market; this is high value-add intelligence when they are writing compelling research. If you’ve got, see if you can trade it. They’ll be happy you got in touch.

The Market Opportunity Breakout

Generate the following market opportunity estimates:

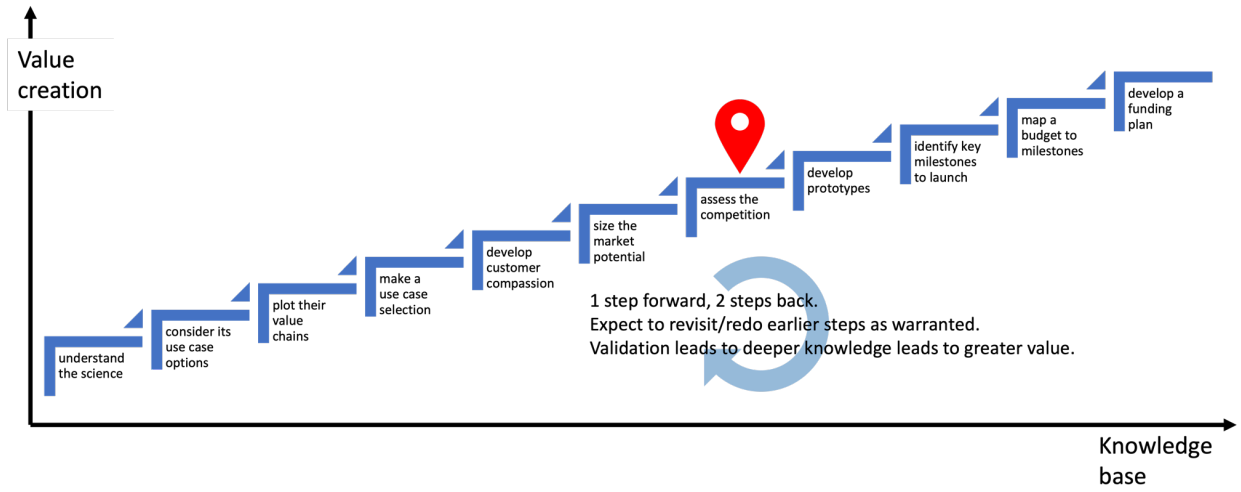
- Your TAM for the next 5 years. Include your sources and assumptions.
- Your SAM for the next 5 years. Include your sources and assumptions.
- Your Sales Plan for the next 5 years. Include your sources and assumptions.

Determine where your innovation currently resides along the Gartner Hype Cycle and ensure that adoption dynamics are consistent with your market sizing estimates.

Additional reading:

The Gartner Hype Cycle. Go to the Garner Group website, then type in hype cycle in search. There are also endless articles online explaining how to interpret and use the Hype Cycle tool.

Chapter 7: Competitors & Blue Oceans



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- Created a customer compassion strategy centered on a profile of (1) your targeted user's jobs, (2) the needs, pains, and desired gains related to these jobs, and (3) the steps you can take to resolve them.
- Have estimates of the TAM, SAM, and an annual Sales Plan for the next 5 years.

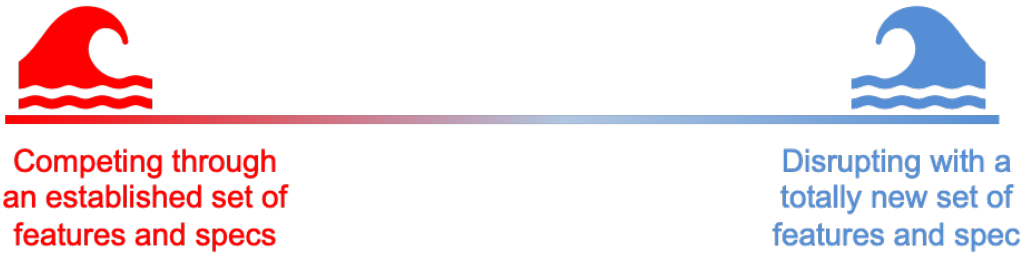
A sober assessment of the competitive nature of your targeted industry is essential to optimizing a commercialisation strategy. With whom will you compete in the existing market, how deeply rooted are their positions, where are their vulnerabilities, are they 100% foe or potentially friend, and is it wiser to create an entirely new market void of established competition?

The competitive assessment must align with the market assessments from the previous chapter, particularly the SAM and the Sales Plan. A rapidly accelerating sales forecast into a mature market dominated by well entrenched players will understandably draw skepticism. Revisiting one's market size estimates after completing the competitive assessment is highly

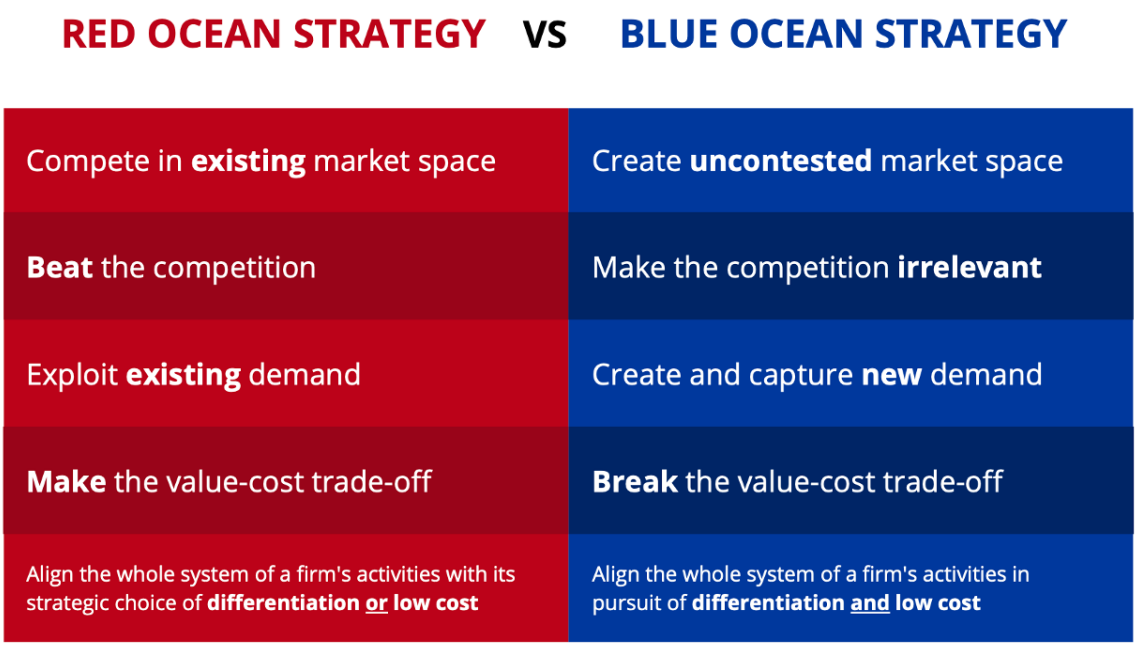
recommended. Size your markets, adjust for engineering hiccups and adoption timing, fold in your understanding of the competitive dynamics, then cast your forecasts. Constantly revise.

Red Oceans, Blue Oceans

In MBA speak there are red oceans and blue oceans. The measure of competition in any given market can be considered across this color spectrum. Red oceans need not be mature, but their competitive dynamics are relatively fixed. Entrants are known and differentiate through conventional qualities. The 1980s PC market is a good example. The home computer revolution was still in early days, but its rules of engagement were relatively conventional. Entrants like IBM, Commodore, and Apple competed on features, price, and brand power; the standard list. Truly disruptive innovation in red oceans occurs at the fringes and year-over-year changes in total market shares are marginal.



Blue oceans reflect markets either just emerging or experiencing notable disruption. Market share is unsettled (or perhaps unknown) and the differentiators of market strength are reimagined. In Chapter 1 readers were asked to place their science innovations along a spectrum of innovation degree: from marginal improvement (deep red) to complete disruption (deep blue). Blue ocean strategies are well suited to highly disruptive innovations that can rewrite the value proposition of an industry significantly. (Think AI in 2023.) Deep tech sectors offer prime blue ocean possibilities.



The introduction of the iPod in 2001, followed by the iPhone (2007) and iPad (2010) created a deep blue ocean for Apple, who had been struggling in the conventional PC market. Apple introduced a new quality to the list of differentiating factors: seamless interoperability. It understood the value in connecting disparate devices with which customers browsed, worked, listened to music, and read books. Layer on top of this hardware the content platforms offering work and design tools, music, and books, and the rules of customer engagement were flipped on its head.

The Blue Ocean concept was conceived by INSEAD professors Chan Kim & Renée Mauborgne and presented in their first book *Blue Ocean Strategy*. The Cirque du Soleil and its disruption of the traditional circus market is an example often sighted as classic Blue Ocean strategy.

Positioning

Every innovation with commercial value has competitive alternatives, regardless of its place on the color palette discussed above. A traditional solution to existing customer need may be one alternative. New solutions in development may represent other market options (in time). Representing one's competitive position helps major stakeholders gauge their interest in supporting the commercialisation effort.

- A venture capitalist needs to know if money invested has an acceptable chance of (eventually) carving out a compelling market position.
- A director of sales or business development you are recruiting needs to know against whom she will be competing and how. (Her commission-based salary will depend upon it.)

- An industrial partner will need to understand how your innovation compares with established technologies and other emerging alternatives.

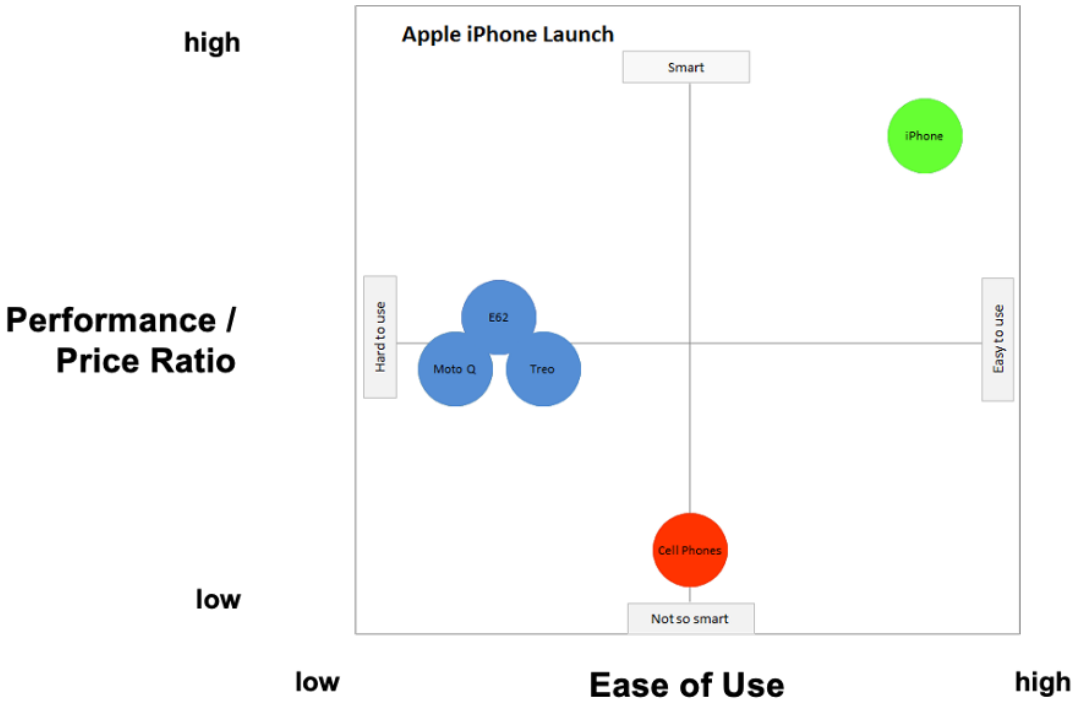
As discussed in the previous chapter, market research is available for most technology markets. Companies like Gartner and IDC offer studies and analysis of a large host of industries, detailing emerging trends, market growth, and competitive assessments. Specialty firms and independent consultants focus on specific technology spaces. High-level analyses may be available for free, but in-depth research is mostly fee-based and it can be expensive. (As mentioned in the previous chapter, if you cannot afford a report that you need then try *horse trading*. Research analysts may value your technical expertise and knowledge about research trends. You want their book. Propose a trade.)

As a startup you may not have the budget for fee-based research reports depicting market positions by annual sales. You can still represent your positioning, specifically on how you compare along the most important metrics, graphically. The graphical style most appropriate for you depends on the solution you're developing. You want to paint the most compelling position possible, while remaining factual and accurate. Stakeholders will see through bullshit. (If it's not possible to represent your innovation's competitive strengths in a compelling fashion, is it worth investing in?)

If uncertain how to position your innovation's strength, consider these two common options: the XY positioning chart and the bubble chart (that is used commonly by *Consumer Reports* magazine when comparing products).

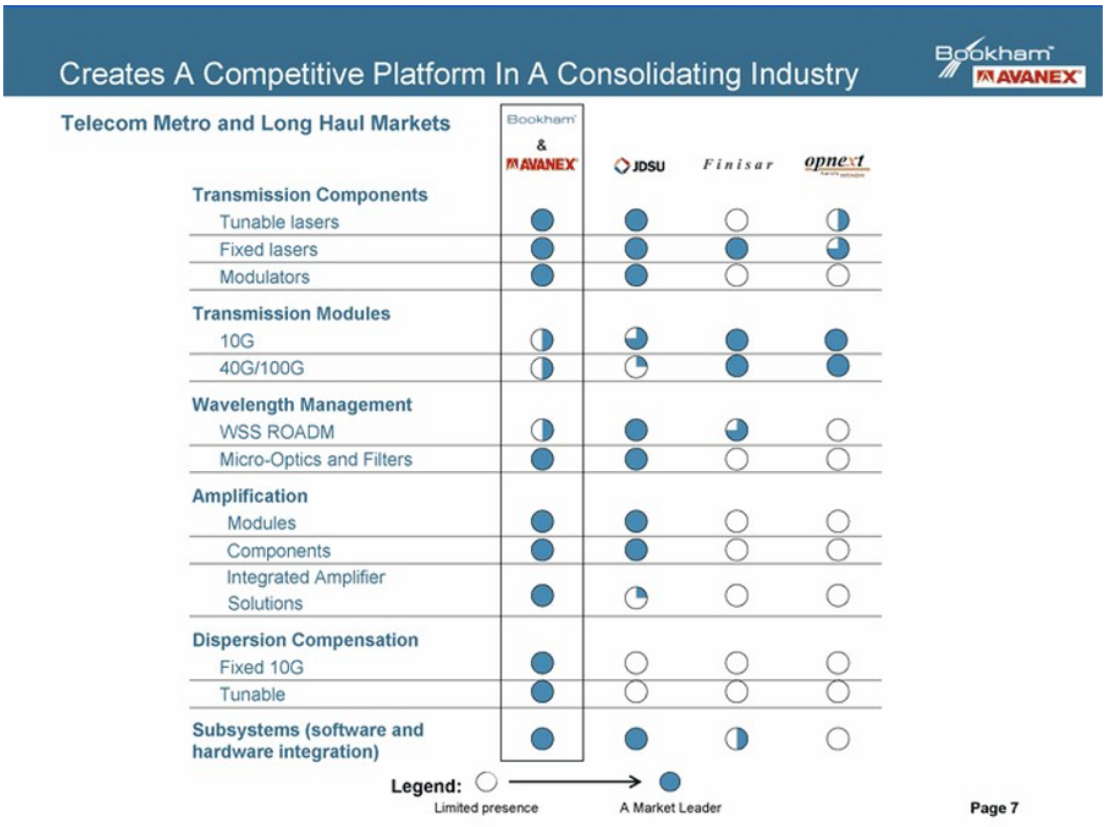
XY Charts

An XY chart plots positioning along 2 axes. Deep tech comparative metrics often revolve around performance advantages (speed, size, capacity, manufacturability, etc.). *Performance per Price* and *Ease of Use* were the 2 metrics selected by Apple when comparing its iPhone at launch to existing smartphones on the market, per the following slide. Choose those that reveal your innovation's greatest advantages and place your position in the upper right corner. Weaker alternatives will be below and to the left of your dominant spot. It's a matter of emotional optics.



Bubble Charts

The bubble chart provides more granularity on relative advantages. Each bubble in the chart will be filled by a quarter, a half, three-quarters, or fully depending on how it meets the feature or availability, again, per the *Consumer Reports* standard. Consider it when your innovation excels along a longer list of important features or your company has a broader set of offerings than the competition, as per the bubble chart below, circa year 2000. (Bookham/Avanex was a supplier of optical components for the communications industry during that period.)



Blue Ocean Positioning

“Blue ocean strategy is the simultaneous pursuit of differentiation and low cost to open up a new market space and create new demand. It is about creating and capturing uncontested market space, thereby making the competition irrelevant.”

- Chan Kim and Renée Mauborgne

According to Kim and Mauborgne Blue Ocean alignment occurs when utility exceeds price to the customer, and price exceeds cost to the supplier. To conduct a Blue Ocean analysis on your innovation, run tests in this order and leverage these tools by the Blue Ocean Institute (instructions on these tests can be found here):

1. Strategy Canvas 1: Start by breaking down your existing industry situation.
2. 4 Actions Framework (ERRC Grid): Eliminate or reduce factors that the industry competes on now. Raise or create factors the industry has never offered and your deep tech solution can exploit.
3. Strategy Canvas 2: Overlay your strategy.
4. 6 Paths Framework. Consider alternative markets, partners, buyers, and other elements outside the conventional boundaries of your industry.
5. Tiers of Noncustomers: Rather than focusing exclusively on growing your traditional customer list, investigate non-customer opportunities to expand the universe in which you compete.

6. Buyer Utility Map. Where can you create value for your buyers, from purchase to disposal?
7. Strategy Canvas 3: After running steps 4-6, revisit Canvas and update.

For deep tech innovations there is a natural tendency to focus on the disruptive nature of the product. But disruption is simply the means to an end: value creation is all that matters in commercial markets. An innovation's disruptive highlights will create the biggest marketing splash at production introduction. But it is value creation that will establish a stronger competitive position and create the greatest value for the innovator firm over the long term. "Technology is oftentimes catalytic to value creation – the technology enables the creation of value – but the technology itself is not the value." (From Search For Value: Value Innovation versus Technology Innovation. Kim, Mauborgne, Olenick. 2021)

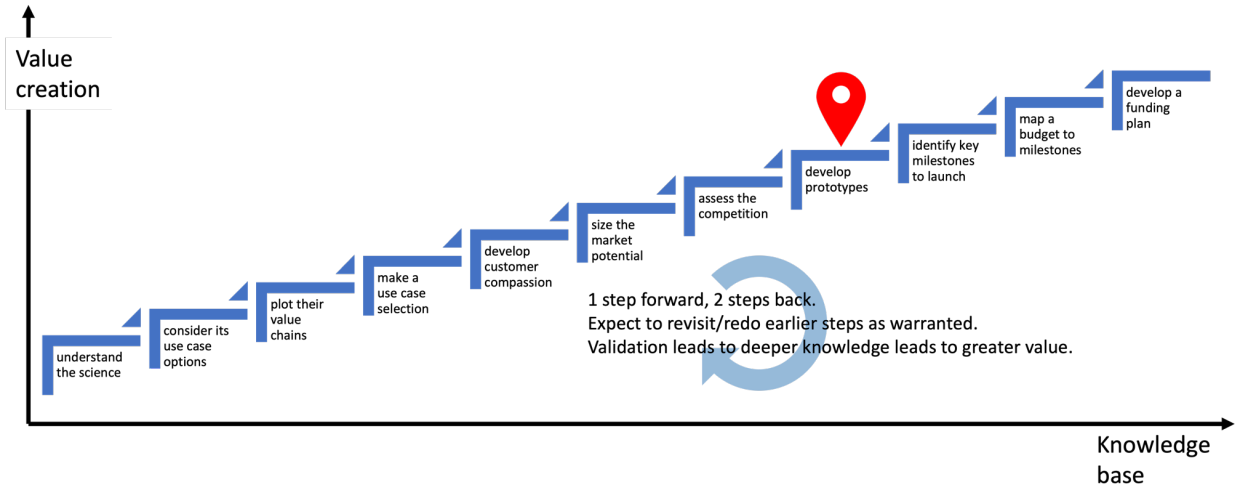
Competition Breakout

- Refer back to Chapter 5 on customer compassion and describe the job or undertaking your customers are doing that involves your innovation. Describe your innovation's unique value in resolving their challenges and boosting their gains.
- List all competitive efforts that pursue your target customers with similar technology solutions. (These can be companies, research labs, university programs, or other.)
- List technical approaches different than yours that can also address your customers' needs, and the companies, labs, programs, etc. that sell or develop them.
- Building on these lists, design a graphical representation that compares your innovation's effectiveness in delivering value against your competitors or the general market. Optimize the graph's design to magnify your innovation's key differentiators.
- Is there a Blue Ocean strategy for your innovation? To answer, run an experiment with the 7 steps highlighted in the previous page (instructions on these experiments can be found at the Blue Ocean Strategy website). Ensure that you clearly define:
    - Your value using the *4 Actions Framework*.
    - Your customers using the *3 Tiers of Noncustomers* approach.
    - Your offering as compared to the established industry using a *Blue Ocean Strategy Canvas*.
- Then, decide on the merits of a Blue Ocean strategy, or adapting some elements of one.

Additional reading:

The Blue Ocean Strategy website.

Chapter 8: Prototyping and Product Evolution



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- Have estimates of the TAM, SAM, and an annual Sales Plan for the next 5 years.
- Have assessed your competitive placement along the ocean color spectrum of red to blue, and illustrated your advantages vis-à-vis the competitors in clear, compelling graphics.

If you're progressing through this playbook sequentially, you'll have had initial discussions with customer archetypes about your innovation and identified your optimal product placement in the value chain of the industry. You'll also understand the "unfair advantage" that your innovation promises and the feature set desired to most effectively amplify this advantage and distance itself from the competition. (Building commercialisation models is an iterative process, of course, so these assumptions may change significantly in time.)

A short word on pretotyping in deep tech

Pretotypes, short for *pretend prototypes*, are nonoperational product mockups, invaluable for validating (often disproving) physical design intentions for hardware innovations, or the user interface and experience in digital innovations such as apps. How to know if the product experience you imagine will be embraced by your target users? Create a pretotype - often in an hour or a day - that can be shared for feedback. Nothing is happening *behind the curtain* in a pretotype, but the user gets a good sense of the dimension, weight, buttons positions, product design, and possibly key features. Pretotypes are particularly useful in deep tech innovation workshops, allowing student teams to experiment with physical productization options that can be shared with other workshop participants over the course of a few days.

The rest of this chapter will focus on the evolution of functional prototypes for deep tech ideas.

For more on pretotyping refer to the excellent work by Alberto Savoia at his home page here.

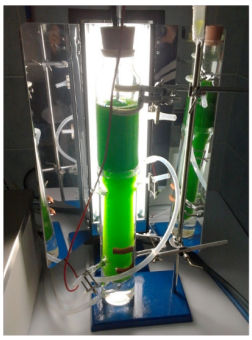
Pre-release evolution

Product commercialisation means evolving that lab achievement that incited initial excitement into a product that can be manufactured to spec at scale. That evolution requires 3 major stepstones along the product development process:

1. Proof of Concept (PoC): Prove that the science works as theorized (repeatedly) on a lab bench, in a petri dish, etc.
2. Prototype (or alpha prototype): Assemble that functionality into an autonomous unit (be it a material, component, module, full system, or other rendering) that meets the core functional claims of the concept. This can be assembled into an inelegant one-off and not to the final form factor. It will be tested by you at your facility and shared with a small number of “friendlies” and other stakeholders for feedback.
3. Minimum Viable Product (MPV, or beta prototype): Improve on the productization to meet a *minimum* set of core specs – size, power, speed, etc. – of the final commercial design that most effectively express its greatest value. The form factor should be elegant and close to the final product. It might not yet be fully featured, but the specs that have customers most interested need to be met. The MVP needs to be available for testing by a larger number of target customers and other stakeholders, at their facilities and should provide a good sense of its capabilities and the user experience.

Example of 3 levels of prototypes for a photo-bioreactor.

Proof of Concept
Does it work?



Alpha Prototype
Can it be assembled?

MVP
Can it be productized?

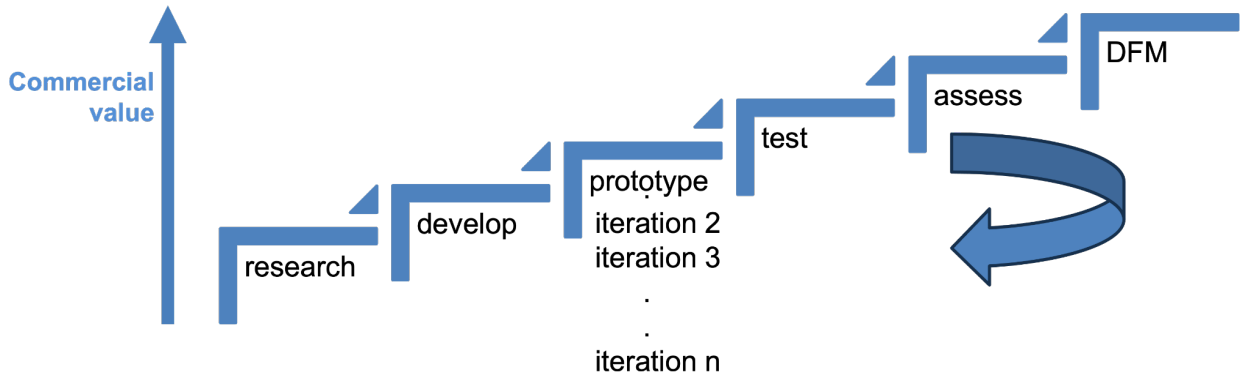
Post-release evolution

Your MVP will be the final product version before commercial release: v1.0. Then what? All innovations need a roadmap of successive feature and performance enhancements: versions v2.0 and on. No investor will back a startup offering a static product that cannot grow with the market need. A large industrial acquirer or licensor will want to know that the innovation being acquired can evolve in pace with its own in-house offerings. That accomplished VP of Sales you want to hire needs to know that a series of amazing offerings to sell in the years to come are in the pipeline.

Developing a product roadmap is key to understanding the evolution of your product design and needs to be shared with key stakeholders. Apple's sales of the original iPhone are estimated at 6 million (Apple doesn't release the exact data), an impressive debut but small in comparison to the success of future releases. Total sales are closer to 3 billion devices today because of a successive rollout of richer features. Just a few new features or each successive iPhone rollout over 4 years include:

iPhone	2007	camera, finger resizing, touch screen
iPhone 3G	2008	video, GPS, Appstore
iPhone 3GS	2009	compass, accelerometer, voice control
iPhone 4	2010	2 cameras, gyroscope, Siri

Building prototypes



Building prototypes of your innovation is key to starting the process of optimizing product spec to market need; to strengthen Product-Market Fit. Early user feedback is essential for focusing on those features they love and eliminating those that they don't. Is it the right dimensions, weight, and color? Does it plug in or bolt up seamlessly to products above and below on the value chain? Does it operate as designed? In the users' opinions, what essential features are missing, which nice-to-have features would add value, and which features are of low interest (and they don't want to pay for)? In sum, how can you make it better?

Prototypes streamline product design investment in 2 fundamental ways: the physical design and the performance design:

- Look-like prototypes: testing these, users will confirm that the physical specs - dimensions, weights, colors, assembly/disassembly, packaging, and other - are correct (or not). How would the user improve it?
- Work-like prototypes: testing these, users will confirm that the operational aspects - power needs, processing speeds, precision, repeatability, and other - are known and meeting or exceeding expectations (or not). How would the user improve it?

The sooner you can get started on a prototype the better, especially to get user feedback on performance expectations before wasting precious time and money on poor designs. If early iterations look kludgy that's okay, it is an iterative process. As your understanding of customer expectations improves an MVP will take shape that more closely resembles a final product that excites the market.

Developing prototypes for mobile apps can be fast, easy, and inexpensive. For deep tech innovations this is often not the case. It may indeed be the biggest challenge you will face on the road to innovation commercialisation. Gaining access to specialized equipment, highly trained staff, custom design tools, ISO-certified clean rooms, 3D printers, laser spectrometers, and other expensive assets while operating on pre-seed funding or small grants frustrates the situation. A sizable Series A investment round may be needed to fund access to the prototyping resources required, but few VCs are willing to make that kind of investment until a prototype has been produced. It's a conundrum.

As of this writing, no perfect solutions exist to this challenge for many aspiring entrepreneurs in the deep tech world. Various approaches to reducing the problem are available, depending on a founder's situation. They include:

University labs	The good: access to high-end, specialized equipment and qualified scientist support, at the university's expense. The bad: limited time per week in the lab, which is shared with other professors and students.
Prototyping houses	The good: rapid turnaround to relatively standard designs. The bad: expensive and may struggle with exotic designs.
Startup incubators / accelerators	The good: access to facilities as part of incubator fees. The bad: the equipment will be purchased for the general needs of all incubator residents, so highly specialized equipment for your specific innovation may not be available.
Industrial partners	The good: access to high-end, specialized equipment and qualified scientist support, at the partner's expense. The bad: the partner may bias your prototype spec to their specific needs and want an equity stake in your startup for their support.
*VC funds	The good: access to high-end, specialized equipment and support at the investor's expense. The bad: there is little downside here. Just remember that VCs, by their charter, operate on a transactional basis that improves ROI.

*SOSV, through its HAX program, is pioneering the effort among deep tech VCs in supporting the prototyping needs of its portfolio companies.

Product Development and Prototyping Breakout

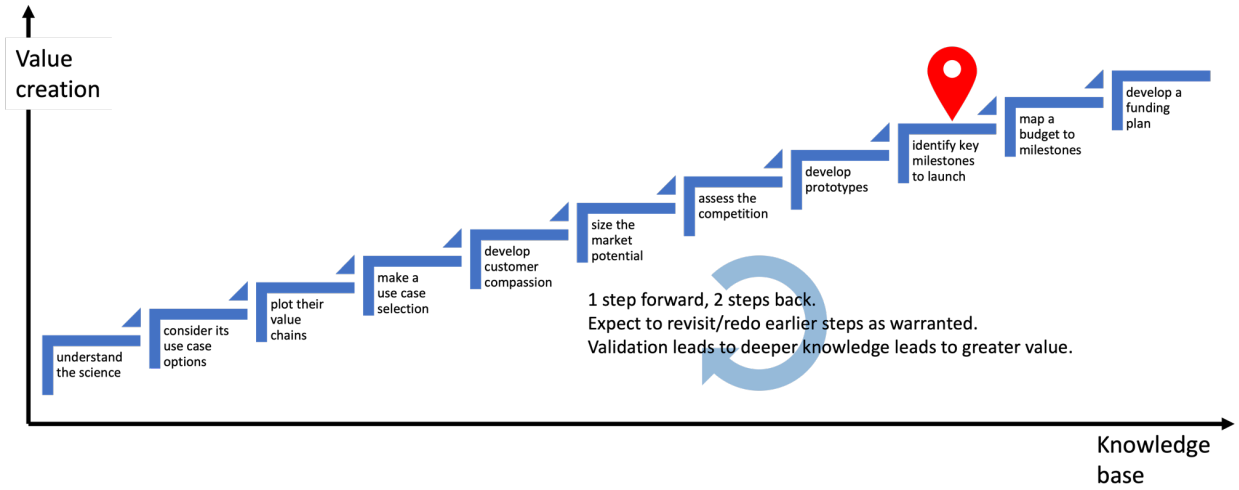
- Establish the current status of your innovation and list the defining characteristics of each successive version according to the following table guide. The Versions and Customer Profiles listed are simply a guide. Your cells may be filled in differently.

Version	**Target**	**Defining Features & Specs**

POC	Internal team, pre-seed investors	
Prototype	Industrial partners, early evangelists, seed investors	
MVP	Pending first customers, Series A investors	
Release v1.0	General market	
Release v2.0	General market	

- For each pre-release version in the table above, is it fulfilling the needs of work-like prototype, look-like prototype, or both?
- What resources and assistance will you need to get each pre-release version of your innovation built?
    - University lab, prototyping house, incubator facilities, or other?
    - Would a digital rendering be sufficient to convey the innovation?
- With whom can you test each pre-release prototype to assess its feature set and product-market fit?

Chapter 9: Milestones to Market Launch



To start this chapter you should:

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- Identified the single most attractive use case and agreed amongst the team that it warrants pursuit.
- Created a customer compassion strategy centered on a profile of (1) your targeted user's jobs, (2) the needs, pains, and desired gains related to these jobs, and (3) the steps you can take to resolve them.
- Have estimates of the TAM, CAM, and an annual Sales Plan for this innovation over the next 5 years.
- Have assessed your competitive placement along the ocean color spectrum of red to blue, and illustrated your advantages vis-à-vis the competitors in clear, compelling graphics.
- Understand your innovation's product form and features evolution from PoC through MVP and first commercial product launch, and have identified those new features that will characterize subsequent commercial versions.

The process of moving an innovation from discovery to a commercially available product does not follow a linear, orderly path. As you push across that grand fecund pond nurturing and challenging the idea-to-prototype-to-product migration there will be a series of starts and stops, stumbles and advances, and a disorderly saw-tooth pattern of (hopefully) forward momentum.

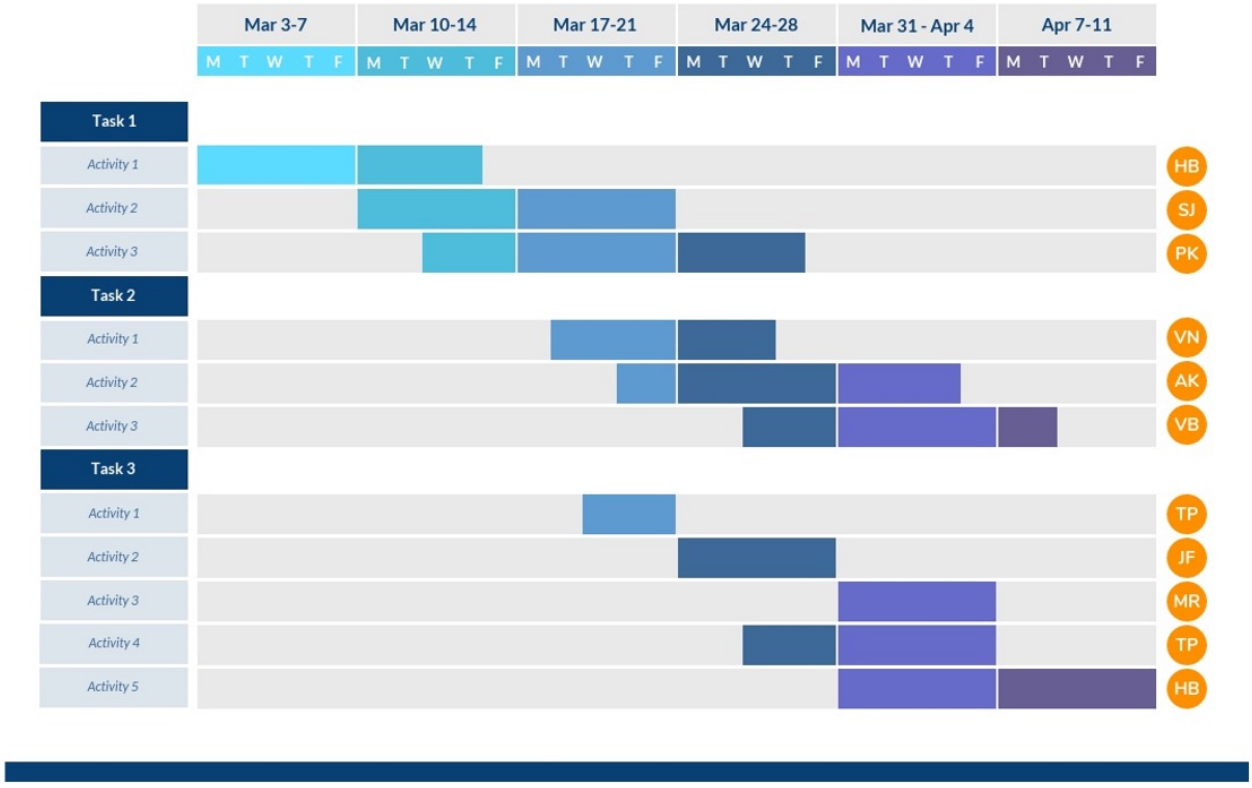
You are not a frog breast-stroking methodically across a calm surface. Rather, you are making leaps from lily pad to pad, some which gave away. You'll be working to move development forward one achievement at a time, then preparing your next leap.

Milestones measure the pace and progress of the commercialisation effort. Plotting them forward is essential for:

- Understanding the key achievements that will mark forward progress.
- Projecting the time and resources required to meet these achievements.
- Communicating the timeline and key markers of this plan to stakeholders like investors, partners, and the team.
- Helping investors estimate the capital required to get the product released and the company to a cash-flow positive state.

Deep tech commercialisation milestones will fall into 5 categories: IP rights acquisition; product development; customer development; key hires; and finance. A multitude of subcategories will fall from each of these buckets, depending on the specific innovation and its road of milestones to market. Using a Gantt Chart or similar tool is encouraged to visualize and synchronize the many milestones and their related action items.

Gantt Chart



IP Acquisition

The long road to commercialization starts with having or securing control over some or all of the core innovation. This may be through legal patents or guarded trade secrets. It may come with boundaries around the applications, geographies, or other market-specific delineations of your exclusivity, to be negotiated with a tech transfer office or inventor. The internet is full of resources on these topics, and time spent with an IP attorney up front can be invaluable. Before embarking on the long and expensive journey of commercializing a deep tech innovation, ensure that you have the IP secured.

Product Design and Development

Once the IP is secure, milestones will revolve around the design and production of the PoC, prototype(s), MVP(s), and commercial launch, as discussed in the previous chapter. The “(s)” are included as a reminder of the iterative nature of the product engineering process, with its many projections, adjustments, redesigns, and assembled versions. Large investments in capital equipment may be required to enable product development. What equipment will be needed, when, and how much will it cost?

Customer Development

We purposely use the term “customer development” as opposed to “market development” here. Deep tech markets tend to concentrate around a few or a few tens of key players, not the thousands or millions (or billions) of customers common to B2C markets in the digital innovation realms. There are exceptions of course, but mostly likely you’ll have a short of list of large organizations in your crosshairs. First customer contact, prototype testing, non-recurring engineering (NRE) agreements, first volume purchase orders (POs): these are just a few of the many customer milestones that can mark your progress in the market.

Team

Many deep tech companies start with a university professor and one or more of his or her graduate students spinning out their research. The team is tiny and fluid. Titles are assigned but mean little, as the focus is on the science and building a product around it. Everyone takes on every task. As the startup matures, responsibilities need to become clearer and more formalized. Key hires in business development, sales, HR, and finance become crucial in evolving the company from a small group of scientists to a more balanced and mature business. Finding and hiring key talent for these roles are important milestones, and the company needs a time map as to when each key slot should be filled.

Funding

All deep tech startups require external capital to get to a cash-flow breakeven point. The timing of grants, pre-seed, seed, Series A, and other rounds of equity and debt financing need to be plotted out at least 3 years (you can make longer forecasts, but they will likely change substantially). Major cash in and out events should also be projected as milestones. These

include sales and other revenue-generating highlights (first NRE, for example), and the purchase or lease of critical assets such as facilities or equipment. As in the previous examples, attaining these targets will reflect a company that can not only meet its financing forecasts but achieve the performance milestones enabling them.

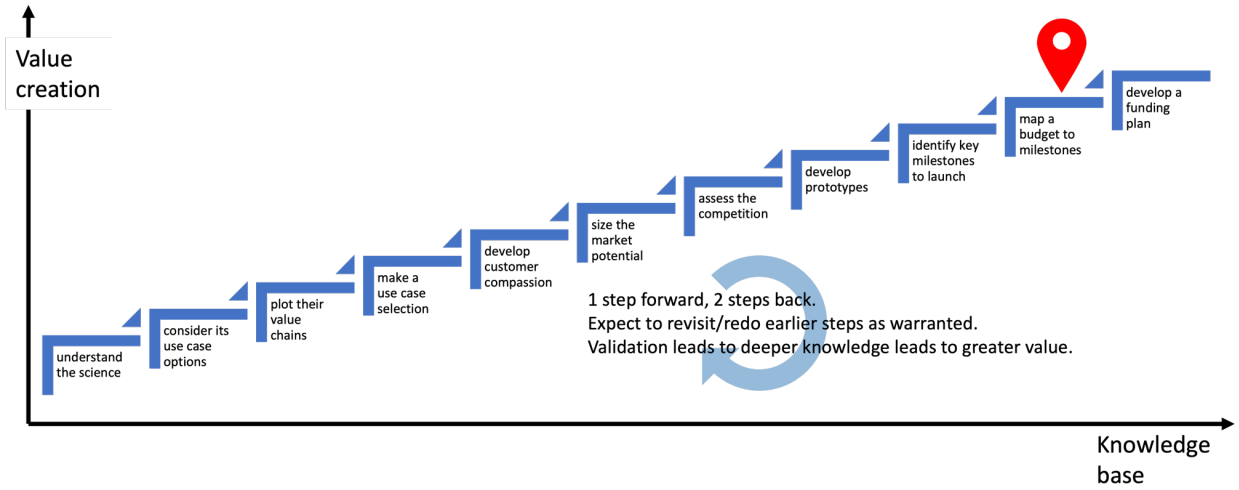
Milestones to Market Launch Breakout

Establish milestone charts for each of your 5 core areas: IP acquisition; product development; customer development; key hires; and finance. These can be Gantt charts or other time-dependent maps or graphs. If helpful, use project planning software to facilitate your milestone setting work. Numerous platforms can be found and compared online:

For each of your charts:

- Create a list of all major targeted tasks in chronological order.
- Identify the major milestones among these tasks that highlight forward progress and enable subsequent advances.
- Identify dependencies among the milestones across your 4 charts and ensure that the timing seems logical and possible.
- Share the timeline with your entire team, to ensure that buy-in is unanimous.
- Add supplemental documentation to the charts so milestones are well defined and the plan for their achievements are clear.

Chapter 10: Budgets



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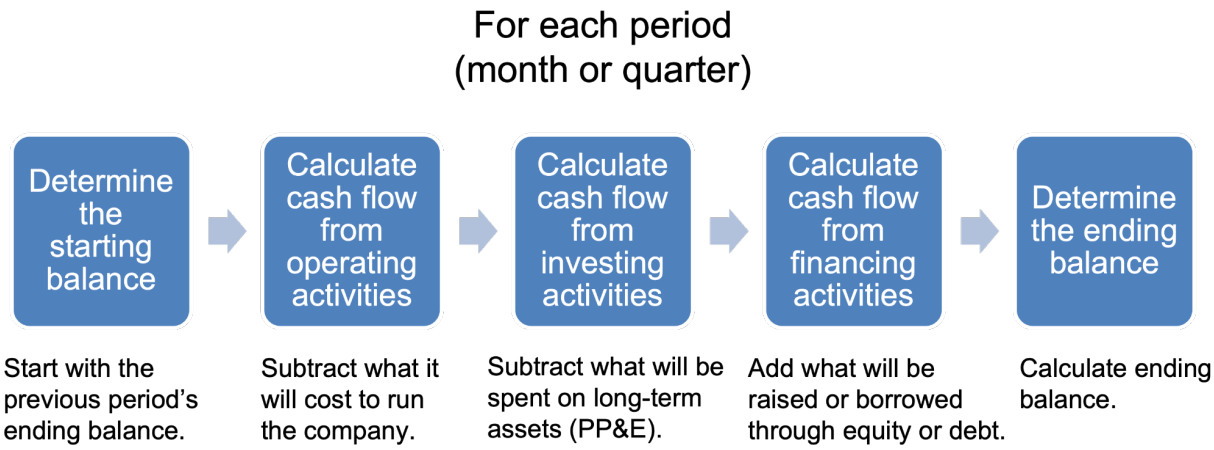
- Have estimates of the TAM, CAM, and an annual Sales Plan for this innovation over the next 5 years.
- Have assessed your competitive placement along the ocean color spectrum of red to blue, and illustrated your advantages vis-à-vis the competitors in clear, compelling graphics.
- Have 5 synchronized timelines (IP, product, customer, team, and finance) of major milestones from launch until commercial market introduction.

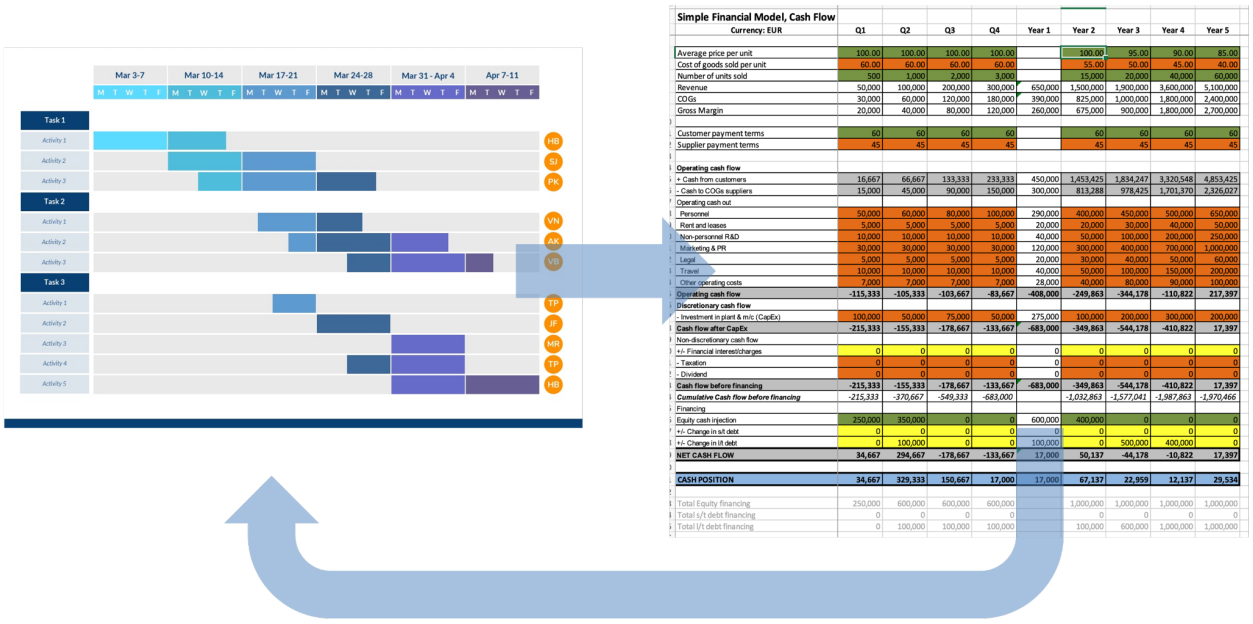
Chapters 9, 10, and 11 - on milestones, budgets, and fundraising - work together conjointly. Pursuing milestones will burn cash that needs to be financed. So, casting a budget that supports the milestones that get your innovation from now until a cash flow break-even point is essential.

The only accounting document required at this early point of an innovation's commercialisation is a cash flow statement. It shows each period's beginning cash balance, the burn associated with operating expenses on the sheet, planned investments for that period in property, plant, and equipment, cash in from debt or an equity issuance (and toss in prize money expected from venture competitions), and the ending balance (which then becomes the next period's beginning balance). Non-cash charges such as depreciation and amortization are important in the wider scope of financial accounting and when calculating profits. It's unlikely you'll be enjoying those for some time. Investors, key hires, industrial partners, and other stakeholders will be focused on cash burn and cash runway. The cash flow statement provides a record and forecast of these measures.



The milestones plan from Chapter 9 will be instrumental in guiding the development of a cash flow statement and vice versa. Are each of the action items, many of which incur expenses or investment, reflected in the budget forecast? Is there sufficient cash available to pursue them in the Gantt chart period assigned? If not, either a cash infusion will be required sooner than anticipated or the action item postponed.

Ensure that your milestones plan and cash flow statement are in harmony. Prepare to spend a few iterations. As with strengthening product-market fit, this takes time and is a continuous process.



Budgeting Breakout

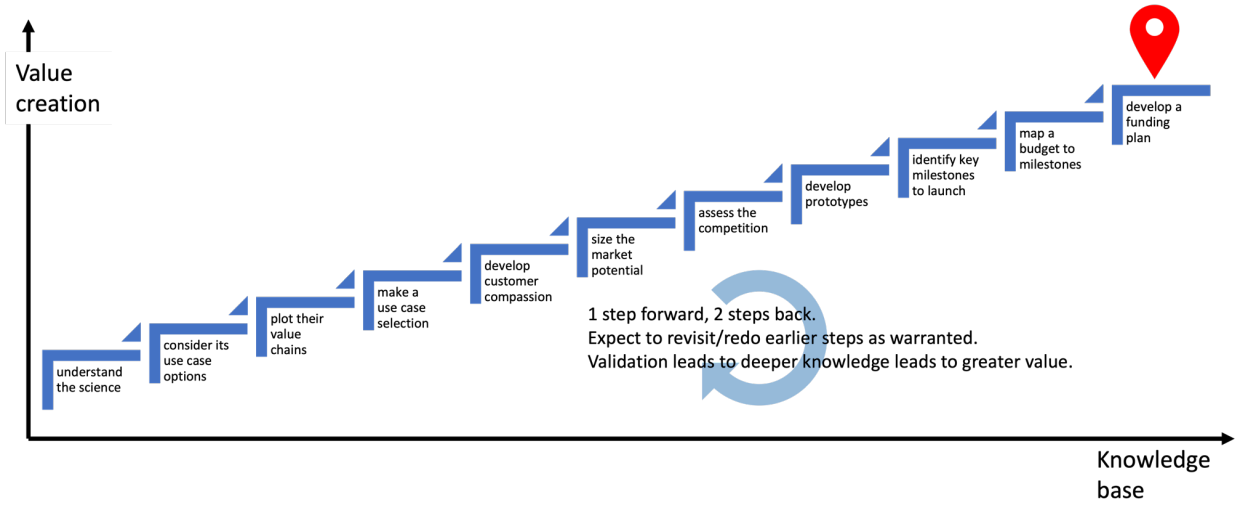
- Create a cash flow statement by quarter that either:
    - brings the commercialisation effort of your innovation to cash flow break-even point, or
    - forecasts cash burn and balances by quarter for the next 36 months.
- Refer to your milestones assignment from the previous chapter to ensure that all major milestones and the spending they represent are included in the budget.

Additional reading:

For an Investopedia primer on cash flow statements click here.

Numerous organizations provide current salary information online including Glassdoor (click here) and SalaryExpert (click here).

Chapter 11: Fundraising



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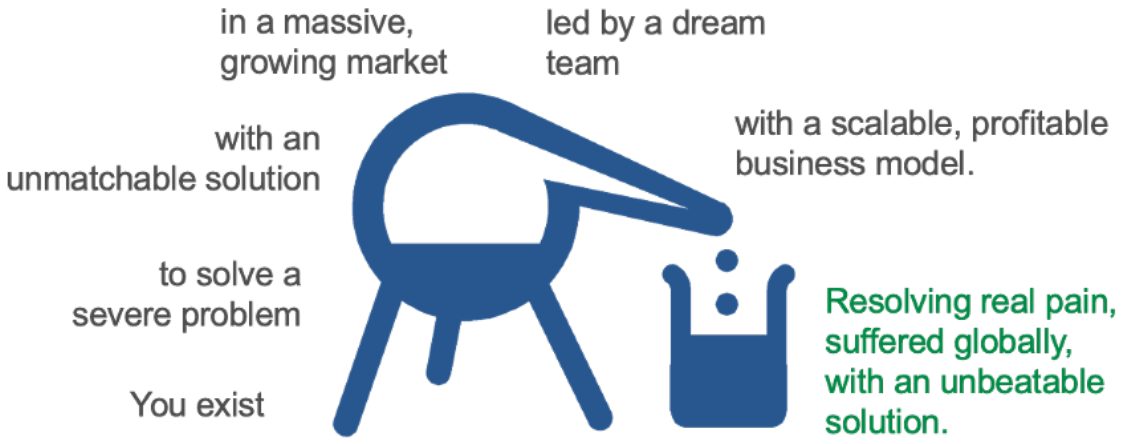
- Have estimates of the TAM, CAM, and an annual Sales Plan for this innovation over the next 5 years.
- Have assessed your competitive placement along the ocean color spectrum of red to blue, and illustrated your advantages vis-à-vis the competitors in clear, compelling graphics.
- Have 4 synchronized timelines (product, customer, team, and finance) of major milestones from launch until commercial market introduction.
- A budget of major expenses and cash flows.

If you have been working through this playbook and completing the breakout assignments, then you will have a solid start on the key knowledge and materials needed to launch an effective fund-raising campaign. Dispensers of cash of all stripes, from university competition judges to venture capital investors, seek out startups with the *perfect* investment profile. Perfect doesn't

exist in the real world, but they'll want to tick off as many of profile elements as possible when evaluating your effort. The ideal profile looks like this:



To this point in our playbook you've been working on:

- Why you exist: your Mission Statement. (Chapter 2)
- The problem(s) you solve: customer pains and gains and how you resolve them. (Chapters 4 and 5)
- Product evolution, features, and value chain positioning. (Chapters 3, 5, and 8)
- Your unfair competitive advantage and major competitors. (Chapter 7)
- The market opportunity: your TAM, SAM, and Plan. (Chapter 6)
- The business model's core milestones and budget. (Chapters 9 and 10)

Projecting how you'll budget for and spend money to bring your innovation to market is relatively straightforward. Understanding where that money will come from is more complicated (and changes unpredictably with public stock market gyrations). Entire books are dedicated to this challenge and every fundraising situation is unique to the innovation and markets in question. Still, certain best practices are common across all situations and they will be covered here.

Deep Tech Differences

Deep tech investors seek out opportunities with as many of the standard *perfect* qualities shown above as possible, but they need more as well. Much of this *more* is driven by the deep science nature of deep tech development. It takes years of specialized training and focused research to bring many disruptive scientific inventions to commercial grade. It calls for an extremely deep and narrow expertise that few others can match (which grants you, at least initially, a beautiful unfair advantage). Regardless of any single investor's knowledge about your general sector, don't expect them to match your dive depth in your specific domain. They may need help understanding:

- fundamental performance limits

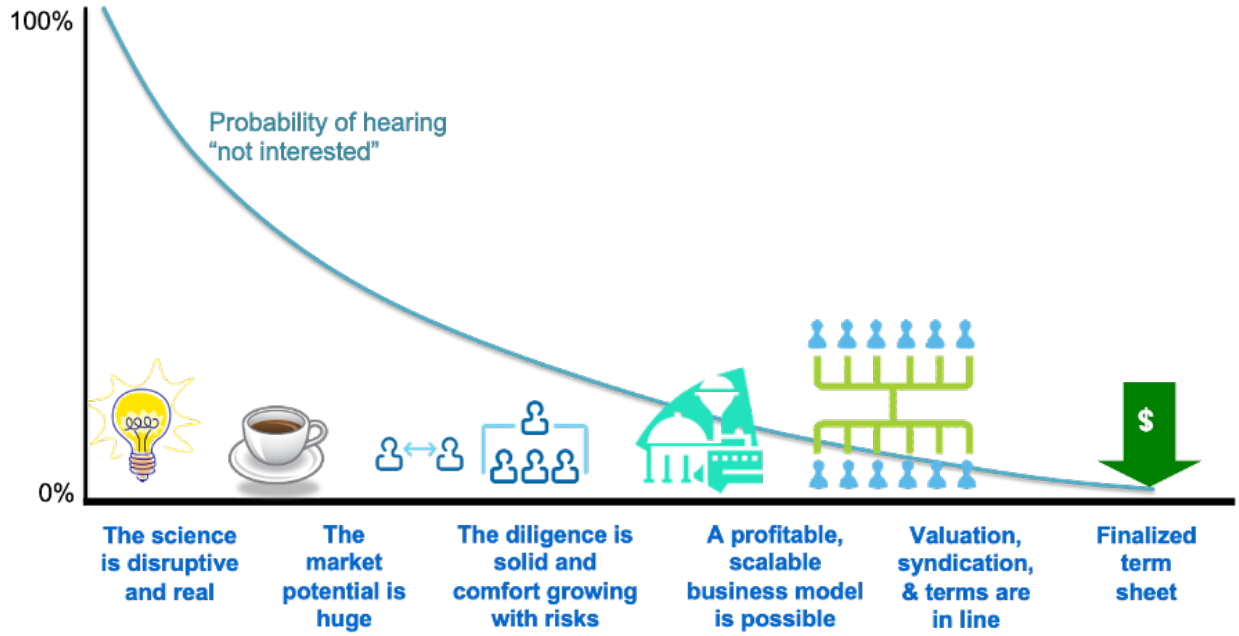
- the pacing of product performance improvement
- prototyping costs and timelines (particularly for specialized tools and equipment)
- commercialization costs and timelines
- required industry standards and certifications
- team needs and how these needs will evolve
- competitive threats (efforts by other universities and industry players)
- industry supply chain dynamics and challenges
- political risks (sourcing/supplying from/to countries like China, Russia, or Iran, for example)
- government or industry support programs (few things are more attractive than free money)

Get a data room started now (in a Google Drive, Dropbox, or other online shareable platform) that addresses these various elements. The collection of information will help potential investors get up to speed more quickly on your innovation and its commercial potential.

The Investment Dance

Firstly, there is no precise, repeatable sequence of investment dance steps to master; that tango you embark upon from the first encounter with a potential moneyed suitor. Every funds-seeker/investor set of interactions from first call or coffee to signed term sheet will be unique. Still, there is a general progression to the relationship built on markers of growing comfort by an investor with the innovation's commercial prospects and interest in committing funds.

In personal relationships a couple has a first encounter, which may lead to dating, which may lead to a proposal and then marriage. The world of high-tech fundraising follows a similar trajectory. It looks like this:



First Encounter (days):

1. You meet an investor in an elevator at a conference and deliver a well-created and expertly delivered pitch in the few seconds while she or he is captive. *A massive market is suffering severe pain that can be best resolved with our peerless invention.* She's intrigued and invites you for coffee to learn more.

   The first go/no-go hurdle is the science itself. Is there something real here being developed, or simply "vaporware" and wishful thinking? Early-stage investors are comfortable with technology risks, but they'll want confidence that no fundamental limits to the science are being violated. Investing in a fantasy that other investors knew would never work is ruinous to one's reputation.

Dating (months):

2. Your initial interactions may be with your first point of contact; the woman in the elevator. If she works in a VC fund then others from her team will soon join the effort – an associate partner and analyst, perhaps – as a concerted diligence dive is undertaken. Market size and growth, competition now and expected, forecasted fixed and variable expenses and long-term capital needs, validation of the science and the sector in general by independent experts, and other diligence requirements. Expect to make regular visits to the fund's offices, perhaps via video, for updates on findings and new requests. It can be exhausting.

   They will also want to visit you and see first-hand how the magic happens. This could

be in a university lab facility or other space from which you are operating, possibly with a small fab and areas for assembly, testing, and prototype design.

3. A major component of the investment analysis will center on the business model. All elements of this playbook explained in previous chapters will be put under a microscope, analyzed, and validated (to the extent possible). Being one step ahead of investor requests will save time, accelerate the investment consideration, and impress upon your suitors that you are well prepared. They'll need comfort not only with your science, its repeatable manufacturability, and the performance advantages, but that it can be boxed, shipped, and serviced in growing volumes profitably. Their analysts may run numerous financial models to understand sensitivity points and areas for concern.

Proposal (weeks):

4. As the major diligence concerns whittle down (or are put into that *acceptable risk* category) a discussion around the terms of an investment will ratchet up. This will include the investment round size and its valuation, of course, but also the syndicate of other investors (a pre-seed or seed round may have a single investor), and the many terms and conditions under which the exchange of cash for equity will be made.

Chapters can be committed to explaining term sheets and how they are negotiated. They include dozens of terms, of which a handful are key to negotiation and the rest are mostly boilerplate legalese. Investors from the US, Asia, and Europe may each have different pain points to emphasize, and negotiation leverage will be heavily influenced by the investment climate of the moment. In bull public markets venture capital tends to be in abundance, putting you, the fundee, in a stronger negotiating position. In bear markets private capital dries up quickly, making it difficult to find investors and lowering your leverage. We include helpful resources on term sheets and their negotiation at the end of this chapter.

Note that in the US a term sheet is a non-binding instrument for debate and adjustment. It is crafted by your lead investor as a starting point for discussion and not a final, definitive offer. Paying an attorney specialized in venture investing term sheets to help you review and propose changes to the document is highly recommended.

Marriage (years)

5. When an investment syndicate is finalized and the fundee and funders have negotiated term sheet harmony, definitive legal documents are drawn up and the marriage is consecrated. Both parties will sign various legal documents formalizing voting rights, stock purchases, and the other terms of the term sheet. Then champagne all around.

Having a fresh round of money in the bank is a liberating, pressure-easing event that marks the next chapter in a startup's life. It also means more oversight through a newly constituted board of directors and regular board (and informal) meetings. The investment dance from first meeting through final signing will have given both parties time to see how well they tango together. A good investment partner will be supportive and guiding, not hostile and overbearing. There are plenty of both archetypes in the investment. Choose wisely.

Fundraising Breakout

- Review your cash flow statement created in Chapter 10. Identify fundraising points along the timeline from now until the project is cash flow breakeven, based on:
    - Timing: fundraisings should be spaced 18-24 months apart.
    - Milestones: your milestone achievements, as projected in Chapter 9, serve as triggers for subsequent financings. Investors will use major milestones to gauge your attraction and value now, and those of future rounds.
    - Cash out. Plan to close any single funding round at least 1 quarter before burning out of cash, then work back at least 6 months to launch a serious fundraising effort.
- Create a slide deck for investors that includes:
    - Why you exist (your Mission Statement)
    - The problem you solve (your users' pains and gains)
    - Your unbeatable solution (the innovation under development)
    - The market opportunity (TAM, SAM, and Plan)
    - The team as it exists now and key posts to fill
    - A compelling business model that is scalable and ultimately profitable
    - Your ask (how much do you want to raise, which major milestones will it support, and how long will that cash infusion last)
- Start a data room with all materials that will support your pitch deck and funding needs.

Additional reading, including links to sample legal documents such as term sheets:

Investopedia terms sheets primer

The National Venture Capital Association

Invest Europe (formerly the European Venture Capital Association)

About the author

Bill Magill started his relationship with deep technologies in the early 1980s, working on laser systems at Lawrence Livermore Labs and the Star Wars space weapons program. This was followed by positions in technology market analysis, Wall Street equities analysis (he wrote the banking industry's first research paper on all-optical networking: "The Appeal of All-Optical Networking, *or How I Learned to Love the Photon*"), and venture capital, where he was a general partner in one of Silicon Valley's leading deep tech funds.

Today, Bill is an Adjunct Professor of entrepreneurship at INSEAD, where he has taught courses on technology commercialisation, asset and startup valuation, private equity, and fundraising. He created INSEAD's Sci-Tech Accelerator, which was awarded 2012 Innovation of the Year by the AMBA, and leads innovation venturing partnerships with leading science centers such as CERN and the European Space Agency. Bill has run workshops on startup creation for other leading universities and incubators around Europe, Asia, Africa, and the US.

Bill is also a musician, playwright, and essayist about *what truly matters* in life. He's a father of 3 and lives in Provence, France.

If you'd like to know how Bill can support your organization's efforts in deep tech venture creation, contact him at bill@interprizegroup.com.

Acknowledgements

This book wouldn't be possible without my collaboration with Adrian Johnson, serial entrepreneur, science geek (possibly worse than me), friend and teaching partner for the past 10 years. Our next iteration of the Playbook will likely include elements of the AI programs Adrian is developing now at his company Qinect.

The playbook also lifts generously from concepts originated by giants in the field of tech entrepreneurship, including Eric Ries, Steve Blank, Alexander Osterwalder, Tom Byers, Eugene Fitzgerald (who invited my VC fund to invest in one of his many MIT deep tech startups), and Paul Kewenehite (who co-directed startup bootcamps with me while at INSEAD). Who am I forgetting?

Oh, and to my 3 kids who provide a reason to get up every morning and go make a living. Love you guys.