Hypothesis-Driven Entrepreneurship: The Lean Startup

Startups are new organizations created by entrepreneurs to launch new products. Upon a startup’s inception, its founders control only their own human, social, and financial capital. They face uncertainty about whether they can mobilize the additional resources required to make and sell a new product. Likewise, the entrepreneurs confront uncertainty about demand for the new product they envision. A startup’s founders thus pursue opportunity without regard to the resources they currently control and do so in the face of great uncertainty.

Consider the ways in which some resource-rich large corporations manage the uncertainty endemic to new products. They diversify to mitigate the profit impact of new product failure. They consolidate their industries to reduce rivalry. And they vertically integrate to avoid input shortages and supplier holdup. These tactics are not available to resource-constrained startups. Instead, entrepreneurs must rely on three other techniques for managing uncertainty: experimentation, staging, and shifting risk to partners.

Combining these three techniques, hypothesis-driven entrepreneurship is a systematic approach for validating a startup’s proposed business model, including risk-sharing partnerships, through staged experiments. When following this approach, an entrepreneur translates her vision into falsifiable business model hypotheses and then tests these hypotheses using a series of minimum viable products (MVPs). Each MVP represents the smallest set of features and/or activities needed to confirm or disprove a business model hypothesis. MVP tests can also generate unanticipated insights about customer and partner requirements. Based on test feedback, an entrepreneur must then decide whether to persevere with her proposed business model; pivot to a revised model that changes some model elements while retaining others; or simply perish, abandoning the startup. She repeats this process until all of the key business model hypotheses have been validated through MVP tests.

Hypothesis-driven entrepreneurship helps reduce the biggest risk facing startups: that they will build a product that no one wants. Many startups fail because they waste resources building and marketing products before they have resolved business model uncertainty. The primary objective of an early-stage startup is not to grow; it is to learn how to build a sustainable business. By bounding uncertainty before scaling, a startup optimizes its use of scarce resources. This boosts the startup’s valuation before it must raise new capital for expansion, minimizing dilution of the founders’ equity.
Entrepreneur Eric Ries coined the term “lean startup” to describe firms that follow the principles of hypothesis-driven entrepreneurship. In this context, “lean” is often misinterpreted as meaning that a firm is bootstrapping, keeping costs to a bare minimum in order to rely only on its founders’ personal resources. Rather, lean startups espouse the same objective as firms that embrace lean manufacturing: avoiding waste and optimizing, not minimizing, resource expenditure. A lean startup may eventually invest enormous capital in product development, infrastructure, or customer acquisition, but only after its business model has been validated through a series of rapid but rigorous tests.

Time is typically an entrepreneur’s scarcest resource; speed matters. Like lean manufacturing, the other intellectual antecedents of the lean startup method—entrepreneur Steve Blank’s customer development process, agile software development methods, and the rapid prototyping of design thinking—seek to accelerate the tempo of hypothesis testing by relying on small batches and short cycle times.

This note’s first section explains, step-by-step, the process of formulating hypotheses, testing them, and then acting on test feedback. The note subsequently considers how the hypothesis-driven approach harnesses the power of human judgment and intuition while mitigating cognitive biases. The final section asks what settings are best suited for hypothesis-driven entrepreneurship.

**Hypothesis-Driven Entrepreneurship: Process Steps**

In this section, we examine the process of hypothesis-driven entrepreneurship and explore the principles behind lean startup practices. Figure 1 depicts these steps. Appendix A contrasts the lean startup method to other approaches used to launch startups.

*Step 1: Develop a Vision*

Before an entrepreneur can generate business model hypotheses, he must have a vision for the problem that his startup will address and a potential solution for that problem. This initial step of developing a vision, also called ideation, is less subject to “by-the-book” instruction than the other stages in the lean-startup launch process. Ideation is a broad topic, beyond the scope of this note, but we offer a few guidelines for generating an entrepreneurial vision in Appendix B.

*Step 2: Translate the Vision into Hypotheses*

Having developed a vision, the entrepreneur then translates it into falsifiable business model hypotheses. As discussed in a companion note, “Business Model Analysis for Entrepreneurs” (HBS No. 812-096), a business model is an integrated array of distinctive choices specifying a new venture’s unique customer value proposition and how it will configure activities, including those of its partners, to deliver that value and earn sustainable profits. Key elements of the business model include the startup’s customer value proposition, technology and operations management strategy, go-to-market plan, and profit formula.
Figure 1: Hypothesis-Driven Entrepreneurship Process Steps

Envision
1. Set vision

2. Translate vision into falsifiable hypotheses

3. Specify MVP tests

Build

Revise
4. Prioritize tests

Pivot
Hypotheses are generated for major business model elements.

Minimum viable product = smallest set of features and/or activities needed to test a hypothesis.

Run low cost/high value tests first. Consider serial dependence and parallel testing opportunities.

Measure
5. Run tests and learn from them

Hypothesis validated
Hypothesis rejected

Learn

Entrepreneur must also remain alert for surprises.

Entrepreneur must guard against cognitive biases.

Decide

6. Persevere, pivot or perish?

Persevere: Have all other hypotheses been confirmed?

Pivot: Adjust vision to accommodate validated learning

Perish

No: time to test the next hypothesis

Yes: Product-market fit achieved. Time to scale!

Source: Casewriter.
Falsifiability  For each of these elements, an entrepreneur formulates a set of falsifiable hypotheses that are consistent with his vision. As with the scientific method, a hypothesis is falsifiable when it can be validated or rejected through a decisive experiment. If a hypothesis is not falsifiable, then “[t]he plan is to see what happens,” and at this, according to Ries, “the team is guaranteed to succeed . . . but won’t necessarily gain validated learning. This is one of the most important lessons of the scientific method: if you cannot fail, you cannot learn.”

For instance, it is almost impossible to fail with a go-to-market hypothesis that says, “Our product will spread through word of mouth.” As long as marketing trials reveal any non-zero rate of word-of-mouth referrals, then this vaguely worded statement will prove true, whether the rate is very low or very high. By contrast, “Our viral coefficient over the next twelve months will exceed 0.5” is a much better hypothesis, one that could be rejected. Whenever possible, entrepreneurs should generate hypotheses that require quantitative metrics for validation.

Sequencing  At a venture’s outset, its founder need not develop detailed hypotheses for all elements of her business model. Business model analysis is an iterative and ongoing process. Due to serial dependence between business model elements, some assumptions simply cannot be analyzed unless others are addressed first. For example, until a team has formulated hypotheses regarding its startup’s customer value proposition, it cannot generate falsifiable hypotheses regarding target customer acquisition costs.

While entrepreneurs should avoid overinvesting in detailed analysis of downstream topics, they nevertheless should make a quick pass through all elements of their business model early in the process of evaluating an opportunity. Back-of-the-envelope analysis is adequate at this stage. The goal is to surface potential “deal-breaker” issues early—in particular, any lack of internal consistency between model elements—and to stimulate a search for ways to address them.

Step 3: Specify MVP Tests

For an entrepreneur confronted with uncertainty and controlling limited capital and team resources, it is essential to maximize learning per unit of time and effort expended. The best way to accelerate learning is, in the words of investor and Y Combinator founder Paul Graham, to “launch early and often.” Uncertainty can be resolved to some extent through traditional market research techniques such as focus groups and customer surveys. (For an overview of research techniques suited for early-stage startups, see “Customer Discovery and Validation for Entrepreneurs, HBS No. 812-097). However, entrepreneurs get far more reliable feedback when they put a real product in the hands of real customers in a real-world context.

How can one launch early and often? By specifying a minimum viable product (MVP): the smallest set of features and/or activities needed to complete what Ries calls a “build-measure-learn” cycle and thereby test a business model hypothesis. By launching a series of MVPs, an entrepreneur reduces product development batch sizes and cycle times, yielding two big benefits. First, short product development cycles accelerate feedback: entrepreneurs learn about customer requirements before investing too much time in building features no one will use. Second, releasing feature revisions in small batches makes it easier to interpret test results and to diagnose problems. If only a few aspects of a product have changed, it is easier to find bugs.

Minimum viable products may be “minimal” in one or both of two ways, compared to the product an entrepreneur might expect to offer when scaling aggressively. MVPs may constrain product functionality and/or operational capability. With constrained operations, a startup relies on temporary and makeshift technology to deliver the MVP’s functionality. The simplest MVPs take the
form of smoke tests that radically constrain both functionality and operations, testing demand for a product that does not yet exist. Appendix C offers some guidance on how and when to use web “landing pages” and other smoke tests.

Constrained functionality With an MVP, test customers experience less than 100%—sometimes much less—of the functionality envisioned for the product once the startup commences scaling. For example, IMVU, whose users socialize in a 3D virtual world, did not initially provide early adopters with the ability to have their avatars walk from place to place, which would have required extensive programming. Instead, it tested an MVP that permitted instantaneous “teleporting” between locations—a much easier programming task. This allowed the team to more quickly test demand for what it perceived to be IMVU’s core functionality: social communications.

In general, if entrepreneurs have hypotheses about which features will be crucial for early adopters, then they should constrain MVP product functionality when:

• Early adopters are expected to be willing to buy a product that offers “need to have” features (e.g., social communication for IMVU), despite that product’s lack of costly-to-develop “nice to have” features (e.g., ambulation for IMVU).

• Certain segments of early adopters (Group A) would never use certain costly-to-develop features that might be deemed “need to have” by other early adopter segments (Group B). Intuit, for example, tested its smartphone application for income tax preparation, SnapTax, by initially offering a version that met the needs only of California residents with one-page 1040EZ returns.

Constrained operations The technology used to deliver the MVP’s functionality is often temporary and makeshift relative to the operational capabilities required for scaling. For example, when they were investigating demand for a social question-and-answer service, Aardvark’s founders relied on human operators rather than computer algorithms to identify individuals in a user’s social network best able to answer the user’s questions. With Aardvark’s “mechanical Turk” MVP, users posed questions using an SMS interface, and then received SMS answers minutes or hours later from people in their extended social network. Users had no way of knowing that humans rather than machines had routed questions to the right parties. With this makeshift solution, Aardvark’s team was able to test demand and learn a great deal about customer behavior before spending time and money developing routing algorithms that would likely have required rework after customer behavior was better understood.

Operational requirements are dictated by product functionality, so entrepreneurs should generally test MVPs with constrained operational capability when they are still exploring customer needs and defining their product’s core functionality. Limiting their test to a small number of customers—a necessity with manual, makeshift operations—permits entrepreneurs to interact directly with early adopters and to learn more about their needs.

Likewise, entrepreneurs should constrain operational capability when it would be costly to acquire such capability and when reliance on a temporary, makeshift solution does not unduly impact customers’ ability to provide useful feedback regarding the functionality being tested. Aardvark’s MVP met these requirements: due to the time required for friends to receive a question and compose a response, users would naturally expect some delay in receiving an answer, even when using the finished, algorithmically driven product. Consequently, the extra time required to have human operators route questions through Aardvark’s MVP had little impact on test subjects’ experiences.
Using a series of MVPs Rent the Runway (RTR), an online service that rents designer dresses, illustrates how entrepreneurs can use a series of MVPs to ensure that customers' reactions to temporary operational arrangements do not unduly skew test results. To test their concept, RTR's founders borrowed dresses and invited female undergraduates to two events—"trunk shows"—where they could rent the dresses. At the first test, 125 women attended and one-third rented dresses. From this test, founders learned that women would rent previously worn dresses and would return them on time and undamaged. They also collected information about which brands, sizes, styles, colors, and price points were popular with early adopters.

The first test had not addressed a key uncertainty, however: would women rent dresses without being able to try them on, a requirement with online rental? At their second campus trunk show, women could view but not try on the dresses. Three-quarters rented in this test, which offered more of the styles that had been popular in the first test.

While RTR’s first two MVP tests had validated several important hypotheses, they had done so by putting women in a social setting that was unlike the solitary experience they would have when renting online. To address this concern, the founders devised a third MVP test to validate demand under more realistic conditions. They e-mailed PDFs of dresses to a sample of women who had asked to be notified about RTR’s launch by registering on the site’s landing page. This trial garnered a 5% rental rate—lower than earlier tests, as expected, but above the predetermined threshold required for a viable business model.

Constraining customer sets Whether they constrain functionality or operations, MVPs are typically tested with a greatly reduced customer set, when compared to the pool of prospects that a scaling startup would target. Acquiring a large numbers of customers before validating business model hypotheses can be expensive and can damage the brand if a subsequent pivot leads the startup to revise its model in ways that drive away the early adopters. Instead, MVPs should be tested with just enough customers to provide reliable feedback. In the case of quantitative tests, this implies samples that are large enough to yield statistically significant results, but no larger.

Common concerns about MVPs Entrepreneurs often express three concerns about “launching early and often” with MVPs:

- **Exposure to idea theft.** Some entrepreneurs worry that an early launch will exacerbate the risk of competitors stealing their concept. In most instances, however, the value of early feedback greatly outweighs any risk of accelerating rivals’ entry. Furthermore, ideas are worthless unless executed, and the iterative MVP methodology helps a startup improve its execution and time-to-market performance. In general, entrepreneurs (and corporate managers) spend too much time worrying about competitors and not enough time understanding potential customers.

- **Reputational risk.** Other entrepreneurs cite the reputational risk of launching an MVP that may have limited features and/or have bugs. The MVP testing approach deliberately limits the target customer base to the minimum scale necessary to rigorously validate hypotheses, which mitigates the reputational impact of any quality problems. Using a different brand name for MVP tests can sometimes also diminish reputational risks. Finally, when a product is used in a mission-critical activity, smoke testing may be a better way to get early feedback.

- **Overreliance on early adopters.** Launching an MVP poses a special challenge when companies must penetrate the mainstream market for their business models to succeed. MVPs are typically sold to early adopters, whose needs may differ from those of mainstream
customers. In particular, there is a risk that early adopters will be “power users” who desire advanced features that would be ignored by mainstream customers. To boost sales to early adopters, it can be tempting to offer such features. Dropbox avoided this temptation. Relentlessly focused on preserving product simplicity, its team sought early feedback from mainstream users, even though such users would not be early adopters. The team also made deliberate decisions to not provide the features most frequently requested by power users, because doing so would compromise product ease of use.

Step 4: Prioritize Tests

After generating business model hypotheses and specifying MVPs to test them, an entrepreneur must prioritize the tests, deciding how to sequence them.

As a general principle, an entrepreneur should give priority to tests that can eliminate considerable risk at a low cost. An example would be a patent search, which often costs less than $2,000. Litigation over alleged patent infringement can shut down a startup. If a lawsuit is a real possibility, then it makes no sense to start building and marketing a product until a patent search is completed. Likewise, when business model elements are serially dependent, then an entrepreneur will have little choice about how to sequence experiments. For example, hypotheses about a go-to-market plan or a technology sourcing strategy often will depend on a startup’s customer value proposition.

Parallel testing Sometimes, however, entrepreneurs will have the option to pursue tests in parallel, because the relevant hypotheses are not serially dependent. For example, the founders of Rent the Runway had to confirm not only that women would rent dresses, but also that designers would make inventory available to RTR. It was by no means obvious that designers would support rentals, since they could conceivably cannibalize retail sales. In response to this concern and in parallel with the trunk show tests of consumer demand mentioned above, RTR’s founders conducted a series of interviews to understand designers’ priorities. After a negative initial reception from several designers, the founders were able to craft a value proposition that focused on the marketing benefits of exposing designers’ brands to young women who could not yet afford retail purchases.

There are trade-offs involved with parallel testing. On the one hand, if an entrepreneur tests hypotheses A and B simultaneously, and A is decisively rejected in ways that render B irrelevant, then the effort expended on testing B has been wasted. On the other hand, if both hypotheses are validated, then the startup gains a time-to-market edge by testing A and B in parallel, rather than in series. When a startup faces a threat of competitive preemption—especially in a winner-take-all market—parallel testing can confer big benefits.

Step 5: Learn from MVP Tests

In the next stage of the lean startup process, entrepreneurs evaluate feedback gained from MVP tests. In interpreting this feedback, entrepreneurs should be on guard against two potential sources of error. The first source of error comes from customers, whose stated preferences do not always correspond to their true preferences. Consider the experience of Facebook in launching two new products: Beacon, which posted information about users’ purchase transactions (e.g., Netflix rentals), and News Feed. Both of these products generated protests from Facebook users. Yet, the former was dropped, while the latter was retained. Why? Because Facebook had data to show that users were engaging with News Feed but not Beacon. Facebook’s management acted on users’ revealed rather than stated preferences.
The second source of potential error in interpreting MVP feedback comes from the entrepreneur herself. Extensive psychological research shows that humans are vulnerable to cognitive biases: they see what they want to see, and they see what they expect to see. Below, in the section on Lean Startup Psychology, we describe several cognitive biases and how they can lead an entrepreneur to misinterpret MVP test results.

In addition to data collected to test the falsifiable hypotheses, entrepreneurs should be on the lookout for surprises as they conduct MVP tests. Surprises come in two forms:

- **Unexpected data about customer usage patterns.** When using a product, customers frequently behave in unanticipated ways. PayPal, for example, was initially designed to allow Palm Pilot users to exchange money electronically. To generate interest for this application, the PayPal team built a demonstration website. The website quickly became far more popular than the Palm Pilot application. Acting on this unexpected insight, PayPal abandoned its Palm Pilot product in order to focus exclusively on the website. Such unexpected insights about customer behavior may come from tracking quantitative measures, or they may come from qualitative interactions with early adopters. For example, soon after PayPal launched its website, eBay users started contacting PayPal asking if they could display the PayPal logo on their eBay auction listings. PayPal’s managers ignored these requests at first. Eventually, however, they realized that these sellers were begging to become PayPal users. PayPal pivoted to focus on these users after both seeing users’ revealed preferences and understanding what was driving them.

- **Noncustomer information.** An entrepreneur may also revise his business model hypotheses based on other sources of information beyond customer usage patterns. Such sources include competitors’ announcements, regulators’ actions, and news about new technologies. Soon after PayPal’s launch, for example, executives at banks and credit card companies told PayPal’s team that fraud was going “to eat them for lunch.” This primed technical cofounder Max Levchin to keep tabs on fraudulent transaction rates.

As illustrated by the PayPal example, entrepreneurs must stay open to surprises. If they mechanically focus only on assessing the data generated to test hypotheses, then founders may miss opportunities or get blindsided by unforeseen threats.

**Step 6: Persevere, Pivot, or Perish**

After evaluating MVP test results and other market feedback, an entrepreneur must decide whether to persevere, to pivot, or to perish.

**Persevere**  If the MVP validates the business model hypothesis and other feedback does not prompt a shift in direction, then the entrepreneur perseveres on his current path, either testing remaining hypotheses or—if all hypotheses have been validated—preparing to scale.

**Pivot**  If the MVP test rejects the business model hypothesis or if it validates the hypothesis, but other feedback indicates that greater opportunity lies elsewhere, then the entrepreneur may elect to pivot. In basketball, a pivoting player keeps one foot planted while moving the other. For startups, the same principle holds: a pivot changes some business model elements while retaining others (see Appendix D for a typology of pivots and examples of each type). In particular, core aspects of the startup’s original vision are typically retained, for example, a commitment to solving a broad problem, to serving a certain customer segment, or to employing a proprietary technology. Consistent with this, Ries defines a pivot as changing strategy while retaining one’s original vision.
Pivoting is neither a goal nor something to be avoided. While pivoting can be costly and disruptive, failing to pivot when assumptions are known to be flawed can be fatal.

**Perish** If an MVP test decisively rejects a crucial business model hypothesis, and the entrepreneur cannot identify a plausible pivot, then he should shut down his business.

*After Product-Market Fit: Scaling and Ongoing Optimization*

If an entrepreneur has validated all key business model hypotheses, then he has achieved *product-market fit.* Product-market fit means that the venture has the right product for the market: one with demonstrated demand from early adopters and with solid profit potential. This in turn implies that the venture can deliver adequate value to all relevant parties: employees will join; customers will buy the product at the price being offered; partners will provide technology and distribution; and investors will be able to earn adequate returns. It is time to scale, to invest aggressively in customer acquisition, and to amass the additional resources required—staff and infrastructure—to serve a rapidly growing customer base. This topic is covered in a pair of course notes: “Scaling a Startup: Pacing Issues” (HBS No. 812-099) and “Scaling a Startup: People and Organizational Issues” (HBS No. 812-100). Appendix E explains why startups should avoid premature scaling.

Entrepreneurs should also continue to utilize hypothesis-testing methods even after confirming their business model assumptions. The purpose of these tests shifts from business model *validation* to business model *optimization.* In the spirit of “continuous improvement,” optimization through rigorous experimentation never ends.

Of course, startups may still need to—or choose to—pivot after they have achieved product-market fit. However, because the costs of doing so are much greater with a scaled-up organization, entrepreneurs are only likely to pivot in response to major and unexpected environmental changes that either disrupt business model elements or present unusually attractive new opportunities.

*Lean Startup Psychology*

The human brain is subject to many well-documented cognitive biases that impair our ability to make reasoned judgments about feedback we receive. While we cannot eliminate these biases, we can mitigate their impact by understanding them and employing strategies to combat them. In this section, we detail four cognitive biases that are especially relevant for entrepreneurs: optimism bias, the planning fallacy, confirmation bias, and the sunk cost fallacy. We also discuss how the lean startup approach helps limit the impact of these biases.

*Optimism Bias*

Optimism bias reflects our systematic tendency to overestimate the likelihood of positive events and underestimate that of negative ones. As psychologist and Nobel Prize–winning economist Daniel Kahneman writes, “The evidence suggests that an optimistic bias plays a role—sometimes the dominant role—whenever individuals or institutions voluntarily take on significant risks.”

This bias can fuel an entrepreneur’s “reality distortion field,” a term coined to describe Steve Jobs’s ability to mesmerize through charisma and riveting rhetoric, inspiring people to advance his vision by changing their views of benefits and barriers. As Kahneman writes of entrepreneurs, “Their confidence in their future success sustains a positive mood that helps them obtain resources from others, raise the morale of their employees, and enhance their prospects of prevailing.”
However, a reality distortion field can also warp its propagator’s perceptions. An entrepreneur may come to believe in her vision so fervently that reality—in the form of disconfirming data—cannot enter the field. In a study of almost 300 inventions that the Inventor’s Assistance Program (IAP) rated as likely to fail, almost half of founders continued working on them after receiving negative feedback from the IAP. This was advice that the inventors had paid for but subsequently disregarded. Of these negatively rated inventions, only five were ever commercialized and none were successful.

An entrepreneur can guard against optimism bias by generating falsifiable hypotheses and tracking performance against them. A pre-mortem may also help his team look more objectively at disconfirming data. In a pre-mortem, a founding team envisions a world where its plan has been implemented faithfully, but the venture has failed. Each member takes a few minutes to write a history of why the venture failed. This process provides an open forum for a team to surface and seriously consider doubts and threats.

**Planning Fallacy**

The planning fallacy is a manifestation of the optimism bias. It reflects our tendency to overestimate the benefits of a task and to underestimate its duration, costs, and risks, even when we have past experience with similar tasks.

Research indicates that it takes web startups, on average, two to three times longer than their founders’ had originally estimated to validate their market. Dropbox founder Drew Houston took even longer. In his Y Combinator application, he projected that it would take him 8 weeks to ship a paid version of his product. It took 18 months to do so.

Entrepreneurs can mitigate the planning fallacy’s impact by (a) being conscious of the fallacy when making intuitive estimates and (b) selecting a reference class of comparable projects for assessing estimates. While reference class data might not be readily available for startup teams working on fundamentally new products, the lean startup approach should nevertheless improve the reliability of entrepreneurs’ estimates. By creating a minimum viable product to rigorously test falsifiable hypotheses, an entrepreneur is making a prediction and then correcting it based on feedback.

**Confirmation Bias**

Confirmation bias reflects our tendency to disproportionately look for, interpret, and remember information in ways that validate rather than reject our beliefs. This bias can diminish decision-making effectiveness when contrary evidence is neglected.

The lean startup approach can help a founder develop a more realistic view of the evidence supporting his business model. But even if MVP tests are interpreted with “eyes wide open,” confirmation bias can creep in earlier in the process, when specifying tests. The founder may unwittingly design tests that return false positives—that is, tests that validate a hypothesis when it is actually wrong—for example, by sampling only enthusiastic early adopters and then extrapolating their characteristics to the mainstream market. When specifying tests, an entrepreneur should explicitly consider ways in which a proposed test might return false positive or false negative results and should keep communicating with skeptics (e.g., with investors who declined to invest). Assigning the role of devil’s advocate to a team member can also ensure that all sides of an argument are presented.
Sunk Cost Fallacy

Sunk costs—expenses that have already been incurred and cannot be recovered (e.g., assets that have no salvage value)—should not be considered when making decisions. Nevertheless, people often fall prey to a sunk cost fallacy, in effect saying, “It would be wasteful to discard all this work, so we should persist.” This is flawed logic: a rational decision maker should focus only on a project’s future expected benefits and future expected costs. But research shows that humans are averse to losses, especially when they are responsible for decisions that led to them. This can make it psychologically difficult for entrepreneurs to pivot to a new business model.

By launching early and avoiding premature scaling, an entrepreneur’s sunk costs are limited and thus less likely to affect her judgment. She may also be less inclined to view sunk costs as losses if she views pivoting as a natural part of the entrepreneurial process and recruits employees and investors based on a vision of the future that includes, ex ante, the possibility of pivots.

Boundary Conditions

As a process that avoids waste and speeds time to market by harnessing the power of human cognition while compensating for its biases, the hypothesis-driven approach is broadly applicable to many types of new ventures—even those for which resources are readily available, such as units of deep-pocketed large corporations (see Appendix F for a discussion of such settings). There are, however, some situations in which the lean startup process yields fewer advantages, in particular: when mistakes must be limited; when uncertainty about customer demand is low; when the quality of information from learning processes is poor; and when long product development cycles preclude “launching early and often.” In these situations, an entrepreneur needs to seek an alternate path or must modify lean techniques.

When Mistakes Must Be Limited

A hypothesis-driven approach relies on the ability to make and learn from mistakes. However, new ventures do not always operate in environments where mistakes are tolerable. Three such situations are especially salient: when there is no postlaunch ability to correct mistakes; when mistakes would impact customers’ mission-critical activities; and when there is limited societal tolerance for mistakes.

For example, once a space mission is launched, its planners have few ways to correct mistakes. As a consequence, a greater focus on contingent planning is required, not the “launch early and often” approach employed by lean startups.

Launching early and often can also pose problems when customers use a new product in mission-critical activities. It is not acceptable for Gmail to lose even 1% of user’s e-mail or for Dropbox to be out of service for even a few minutes. In such cases, a firm may elect to get feedback through a smoke test, as Dropbox did by creating an online video demonstration of product features once it had a working, but not fully debugged, prototype.

Finally, society may legally limit a firm’s ability to make mistakes when testing new products. Such is the case with the development of new pharmaceuticals, where clinical trials must follow strict protocols that prohibit experiments with unproven compounds on human subjects. Efforts to evade such constraints and to learn faster by launching early and often may raise issues about ethics, for example, when moving early pharmaceutical trials to less regulated overseas markets.
When Demand Uncertainty Is Low

There is less need to seek feedback about customers’ needs when there is strong unmet demand for a radically new product. This would be the case for a low-cost cancer cure that produced no adverse side effects. Similarly, there would be strong demand from utilities for a low-cost, reliable, “green” solution for generating electricity that did not produce unpredictable, off-peak spikes in output requiring expensive power storage facilities—a limitation of solar and wind energy. With such new products, entrepreneurs should still follow a hypothesis-driven approach to testing alternative engineering approaches, but there is no need to launch early and often to get customers’ feedback about demand.

When Information Quality Is Low

At times it can be difficult for an entrepreneur to get high-quality information from MVP tests, which reduces the usefulness of the hypothesis-driven approach. This may happen when customers conceal their true behavior or when systems for capturing information are irrevocably flawed.

Customers sometimes seek to hide their true preferences, for example, when they perceive the process of soliciting feedback to be a strategic interaction or when using a product might be considered a vice. In business-to-business settings, potential customers often view customer research as the first phase of a price negotiation and consequently obscure their preferences. In other categories where privacy issues are salient (e.g., health care), some people might wish to hide their identities, consumption patterns, or their true preferences, and the entrepreneur needs to carefully consider the motivations of test subjects before acting on their feedback.

Systems for capturing data on user behavior may also be inadequate. A great advantage of online businesses is that they can collect detailed, real-time information about customers’ usage patterns. For offline businesses, however, comparable systems may be prohibitively expensive; those that do exist may provide noisy information and may do so slowly. For example, a fashion designer who launches a new apparel line may face months of delay in learning whether her products are selling in retail channels.

When Demand Uncertainty Is High, but Development Cycles Are Long

Intrinsically long product development cycles, which are often endemic to entrepreneurial projects that require engineering breakthroughs or massive construction, make it more difficult to launch early and often. If demand uncertainty is low, this doesn’t pose a major problem. But what if development cycles are intrinsically long for a radically innovative product for which there is considerable uncertainty about customer demand? Consider the case of Segway. Until the company had a working prototype of its two-wheeled “personal transportation system,” could anyone accurately predict how early adopters would react to the product?

In this context, there is no possibility of putting a real product in the hands of real customers, early in the product development process. But the entrepreneur should still use hypothesis-testing methods whenever possible to gain insight on target customers’ needs. And he must remain especially vigilant about cognitive biases. Research shows that decision makers who must make big and ongoing investments before outcomes are known are vulnerable to a phenomenon called “escalation of commitment”—a tendency to ignore disconfirming data in such settings and to continue investing. Escalation of commitment follows from all of the cognitive traps described above: optimism bias, the planning fallacy, confirmation bias, and the sunk cost fallacy.
Conclusion

Some experienced entrepreneurs might regard the lean startup approach as “old wine in a new bottle.” Indeed, the core concept behind hypothesis-driven entrepreneurship—test then invest—has been practiced in well-run new ventures for decades. Likewise, product development professionals have long recognized the value of small batches and fast feedback cycles, and practitioners of design thinking have demonstrated the power of rapid prototyping.

The lean startup approach builds on these ideas, but in our view, it goes several steps further. First, the lean startup approach evaluates an early-stage startup’s entire business model, whereas most of its intellectual antecedents focus more narrowly on a startup’s product. Second, the lean startup approach introduces two new concepts: minimum viable products that efficiently test business model hypotheses, and pivots that change certain business model elements in response to failed hypothesis tests. Third, unlike other methods for managing an early-stage venture, the lean startup approach balances the strong direction that comes from a founder’s vision with the need for redirection that follows from market feedback. Finally, the lean startup approach mitigates cognitive biases that may prevent an entrepreneur from recognizing the need to change course or abandon a failing new venture.
Appendix A: Alternative Approaches for Launching Startups

To understand the logic behind hypothesis-driven entrepreneurship, consider three other approaches that entrepreneurs may employ when developing and launching their first product.

Build It and They Will Come . . .

Entrepreneurs sometimes do cursory research on an opportunity and then focus all of their energy on product development. These entrepreneurs are driven by their vision of a perfect product. Their engineering-dominated team works furiously to turn that vision into reality; it does not stop until the product is ready for testing. The entrepreneur’s vision burns brightly, and she doesn’t test business model hypotheses. Like the farmer in the film Field of Dreams, who builds a baseball diamond in his fields after hearing voices in his head saying, “Build it, and they will come,” the entrepreneur makes a leap of faith.

Sometimes, a “build-it-and-they-will-come” approach results from an ego-defensive avoidance pattern. An entrepreneur’s ego is heavily invested in her venture’s success. One way to limit ego damage is to avoid feedback showing that the venture is offtrack. In other instances, a deep dive into product development is a comfortable excuse for hiding in one’s office. Introverted entrepreneurs may be too timid to solicit reactions from strangers.

The risks with a build-it-and-they-will-come approach should be evident. The team receives no customer feedback until the product is built and launched. If uncertainty about demand is high, then the odds of inventing the right product with this vision-driven approach are low.

Waterfall Planning

Other entrepreneurs translate their vision into a plan and then focus all of their energy on methodically executing that plan. Work is completed in sequential stages. Effort on a downstream stage only commences when the preceding stage is completed and successfully passes through the “gate” of a formal review, hence the name “stage-gate planning.” This approach is also called “waterfall” planning because a graphical depiction of how stages are completed over time cascades from top left to bottom right. Stages in the plan typically include:

1. Concept exploration, culminating in a business plan that describes product features, target customers, technical challenges, competitors, financial projections, and so on
2. Product specification, captured in a product requirements document that—at least in theory—provides sufficient guidance on proposed product functionality to allow engineers to begin design work
3. Product design
4. Product development
5. Internal testing
6. Alpha launch with pilot customers to validate technical performance

Steps 3 through 6 above represent the plan for the engineering team. The complete plan includes stages to be completed in parallel by other functions. For example, marketing will develop sales
collateral material once product specifications are complete, then it will formulate a public relations plan, and so on.

Waterfall planning is sometimes introduced to startups by entrepreneurs who learned the technique in big corporations, where it works well when launching line extensions that require coordinated effort across separate organizational units. For startups developing and launching radically new products, however, rigid adherence to waterfall plans can cause problems. After the concept exploration stage, the team typically will not receive much customer feedback until it commences an alpha test. When work is completed in big batches, errors introduced early in a stage may not be discovered until additional work has been completed, requiring rework. Likewise, when the external environment is rapidly changing, assumptions are bound to become outmoded by the time all stages are completed.

Just Do It!

Some founders respond to the dysfunctions of planning—and indulge their penchant for entrepreneurial action—by embracing an improvisational approach when launching their first product. They jump into the startup process with imagination and aspirations, but without a strong product vision or a detailed plan. These founders rely heavily on the ongoing feedback and assistance that they get from people they know and meet. They adapt their offering frequently to fit this input from potential resource providers and customers and to respond to surprises that they inevitably encounter.

This “Just do it!” approach to entrepreneurship has advantages: it leverages scarce resources by tailoring an offering to suit resource providers’ capabilities and preferences. Also, improvisation may successfully steer a new venture, stepwise, toward opportunity. Without a strong vision, clear plan, or hypotheses, however, it can be difficult to know when to make course corrections or what direction they should take. The decision rule guiding adaptations is vague: “If outcomes seem to be improving, keep doing what you are doing, and consider taking a few more steps down this path; if outcomes are deteriorating, stop doing what you are doing and try a new path.” But what new path should the entrepreneur follow? And what is the performance threshold that dictates when to change direction, versus waiting for more input or simply trying harder?

Without a clear initial sense of direction, searching for opportunity through incremental adaptation can pose significant problems when entrepreneurs fail to foresee serial dependence between decision outcomes. Consider these examples of how product design decisions that rely on early market feedback can misfire if they are not integrated with an overall strategy:

- After receiving positive feedback from early adopters, a startup may design its product to meet the needs of power users, only to discover later that its offering is overengineered—too costly and too complex—for mainstream users whose support is essential to harness scale economies.

- After getting encouraging face-to-face feedback from target customers, a startup might launch a product that solves a serious problem for small businesses. However, if the entrepreneur does not anticipate that: (1) direct customer contact will be required to explain the product’s benefits, and (2) the product will not yield enough gross margin to support direct sales, then the entrepreneur may be surprised to discover that his business model is not viable.
If we step back and compare these three approaches for launching a startup, we can see that build-it-and-they-will-come and waterfall planning suffer from a similar flaw: both provide strong initial direction, but make little use of feedback to change direction. By contrast, the “Just do it!” approach embraces feedback, but the absence of initial direction means that some feedback-induced adaptations may turn out to be mistakes, due to serial dependence between decisions. Hypothesis-driven entrepreneurship avoids these pitfalls. This is supported by research showing that startups that pivot once or twice are half as likely to scale prematurely—the leading cause of failure for startups—than startups that pivot more than two times or not at all. An entrepreneur doesn’t need a perfect hunch, but she does need a good one and a way to receive and incorporate feedback. Sequentially testing a comprehensive set of business model hypotheses ensures that pivots—feedback-induced adaptations—take serial dependence into account.
Appendix B: Guidelines for Entrepreneurial Ideation

The following guidelines for entrepreneurial ideation are gleaned from insights shared by entrepreneurs, design thinking principles, and academic research on creativity and innovation.32

- **Immersion.** Creativity usually follows from deep immersion in a problem. For some problems, especially in consumer markets, an entrepreneur's own interests and life experiences are adequate guides for ideation. To identify unmet needs and potential solutions for business-to-business markets, however, an entrepreneur typically must tap the domain knowledge that follows from years of industry experience. If she lacks such experience, the entrepreneur will benefit from closely observing and interacting with customers and/or domain experts, playing the role of anthropologist.

- **Obsession.** Creative individuals become obsessed with the problems on which they are working. They are not, however, unduly devoted to provisional solutions that they conceive during the ideation process; they remain open to new ideas, willing to reconsider their assumptions and prepared to abandon flawed concepts, no matter how much effort they have invested in them. Those that succeed know that early solutions are likely to be wrong or incomplete and that failure is a natural part of the process.

- **Incubation.** Inventors often spend years on a problem before they get an epiphany about a solution; the subconscious remains engaged in problem solving even when inventors—frustrated by barriers or distracted by other priorities—set their work aside for long periods. The notion that solutions may come into focus slowly can be difficult to accept for aspiring entrepreneurs, especially those who commit to launching a startup before they have a vision for what it will do.

- **Recombination.** New ideas often result from connecting seemingly unrelated concepts. Creative individuals are curious; they put themselves in situations of planned serendipity where they will be exposed to diverse ideas in order to harness their associative thinking abilities. They may do this through the variety of contacts they keep in the real world or through the subject matter experts they follow online.

- **Clarification.** Many inventors employ processes to keep track of and refine their ideas. Design thinkers often rely on journals and Post-it notes, but some entrepreneurs find that writing blog posts not only forces them to integrate and sharpen their ideas but also invites helpful responses. Some founders also find that group “white boarding” sessions provide a helpful way to generate, clarify, and prioritize their ideas.

- **Collaboration.** Researchers have dispelled the myth of the lone genius inventor. The prolific American inventor Thomas Edison, for example, surrounded himself with brilliant and determined collaborators in his Menlo Park, New Jersey, laboratory. Most great creative work is done in small teams: think of Lennon and McCartney, Jobs and Wozniak, or Brin and Page. One collaborator will say something that triggers another’s ideas, and cofounders will support each other emotionally when the creative process stalls.

Experts on creativity reject the notion of a playbook for innovation, but entrepreneurs engaged in ideation would be wise to copy two practices of design thinkers. First, entrepreneurs should learn how to run a good brainstorming session. This entails generating as many ideas as possible, in particular, wild ones; building connections between ideas; and avoiding negative evaluation of ideas. Second, entrepreneurs should familiarize themselves with the ways in which design thinkers use crude prototypes.33
Appendix C: Smoke Tests

The simplest MVPs take the form of smoke tests that radically constrain both product functionality and operational capability. The term “smoke test” has its origins in the practice of forcing smoke through plumbing to look for leaks. The lean startup community uses the term to describe MVPs that are made from “smoke”—products that are truly minimal because they do not yet exist.

Before they develop any product features or assemble any operational capabilities, web startups often conduct smoke tests using landing pages that provide a brief description of a planned online service, and then ask page visitors to leave an e-mail address if they wish to be contacted when the service launches. In the context of direct selling to enterprises, an equivalent smoke test asks a potential customer to sign a legally nonbinding letter of intent to purchase an as-yet-unfinished new product (see “Customer Discovery and Validation for Entrepreneurs,” HBS No. 812-097, for a discussion of letters of intent).

If a substantial fraction of visitors register after viewing the landing page, then an entrepreneur can infer that there is some interest in the proposed service. Of course, simply registering doesn’t require a purchase commitment, so the test cannot conclusively validate demand, but it can provide enough evidence to warrant proceeding with additional tests of higher fidelity MVPs. Conversely, if almost no one registers upon viewing a landing page, then the entrepreneur must take stock of her situation. Did the test fail because there is little demand for the proposed product? Or because the entrepreneur doesn’t yet know enough about the problem to describe potential solutions that appeal to prospective customers?

Video MVPs Startups can improve the reliability of landing-page registration tests by providing more detailed product descriptions. For example, Drew Houston, cofounder of the online file storage/sharing service Dropbox, was able to gauge demand by posting a three-minute online video. The video demonstrated Dropbox’s proposed product features, using a working but not fully debugged prototype, and then asked people to register to beta-test the product. Houston’s video MVP illustrates another situation in which smoke testing makes sense: if a product is used in a mission critical activity—like backing up all of a user’s computer files—then it would be irresponsible for an entrepreneur to ask an unwitting customer to field-test an early product version that might have serious flaws.

Charging for smoke tests Startups can also get more reliable data about demand by asking landing page visitors to make a purchase commitment after viewing a product description. Magazine publishers have done this for decades, sending direct mail solicitations for new magazines that have not yet been produced—called a dry test by direct marketers. In the same spirit, Kickstarter, an online funding platform for creative projects, asks potential project sponsors to make a funding commitment after viewing a video MVP. In a typical Kickstarter proposal, an artist shows images of her past work, explains the goals for her next project, and then requests a specific level of funding for that project. The project can proceed only if it attracts a threshold level of funding commitments; if it does not, then sponsors do not disburse funds.

As a general rule, entrepreneurs should charge smoke-test customers whenever they can. This is not possible with a product that is intended to be free to end users, as with an ad-supported service like Aardvark. Likewise, it may not be feasible to ask customers for payment when it is obvious to customers that the startup might not actually be able to build the proposed new product, due to technical challenges.
Appendix D: Typology of Pivots

An entrepreneur may choose to pivot along one or more of the following dimensions of a business model:

- **Customer value proposition: feature set.** A new venture may pivot to a new customer value proposition by expanding, contracting, or entirely changing its feature set. TiVo, for example, originally intended to sell home media servers; the venture contracted its feature set to focus solely on digital video recording, while still retaining its focus on the home entertainment sector. Chegg changed its feature set entirely while retaining its focus on college students: it pivoted from being a Craigslist-style marketplace for university communities to renting textbooks.

- **Customer value proposition: customer set.** A startup may also pivot to a new customer value proposition by expanding, contracting, or entirely changing its customer set. Zipcar, for example, broadened its target market beyond environmentally conscious young urbanites to include young urban professionals, offering BMWs and similar brands to the latter segment—cars that had little appeal for its initial customers.

- **Technology and operations management strategy.** An entrepreneur may choose to expand, contract, or shift the scope of activities that are performed internally, rather than externally by partners. For example, Keurig, after abortive efforts to develop the in-house capability to manufacture packaging line equipment and brewers and to develop its own brand of coffee, outsourced all of these activities to partners.

- **Go-to-market plan.** A startup may change its main methods for acquiring customers. Dropbox, for example, initially expected to rely on a combination of search engine marketing and distribution by partners such as PC security software vendors. When these methods proved uneconomical and infeasible, respectively, Dropbox shifted to viral marketing.

- **Profit formula.** A startup may pivot by changing its monetization approach. Google, for example, initially tried to license its search technology to online portals and other websites before shifting to paid search advertising.
Appendix E: Premature Scaling

A core lean startup principle is that entrepreneurs should not scale until they have achieved product-market fit. Premature scaling can hurt a startup in three ways. First, it relinquishes one of the primary advantages of an early-stage venture: its agility. Unlike established corporations, an early-stage venture can quickly change direction based on new information because it has not committed resources that must be redeployed. Once a startup has started scaling, pivots become more difficult and expensive.

Second, premature scaling risks alienating and confusing large numbers of customers if a startup subsequently must pivot to a new value proposition. If early adopters who have been sold on one premise are told that their purchase was wasted, the backlash can be strong and the reputational consequences for a startup can be severe.

Finally, premature scaling shortens a venture’s runway and thus the number of build-measure-learn cycles its team can complete. As Paul Graham notes, “[t]he slower you burn through your funding, the more time you have to learn.”41 “Runway” is conventionally defined as the number of months required to exhaust a startup’s cash balance based on its expected “burn rate,” that is, negative cash flow per month. Ries has redefined runway as the number of pivots a startup can complete with available resources. Once a startup starts scaling, its burn rate increases and its runway shortens, unless it can raise more capital. Startups that have not resolved business model uncertainty—or put another way, that have not achieved product-market fit—typically find it difficult to raise capital to fund scaling.

Scaling early with network effects The rule “no premature scaling” can be misconstrued to mean, “no scaling until a product earns profit.” The latter guideline may not make sense for platforms that facilitate user interactions and leverage strong network effects.42 Consider Facebook, YouTube, and Twitter. These platforms all launched with, at best, fuzzy plans for making money. Did it make sense for their founders to defer scaling until they had validated a hypothesis about how they would earn profit? No: these firms all relied on ecosystem partners to help experiment with ways to monetize a big platform. Partners simply wouldn’t emerge and couldn’t commence experiments until each platform had a big user base. For example, Zynga, whose social games have become a huge source of revenue and profits for Facebook, was not founded until 2007, three years after Facebook launched. It is often impossible for such platforms to fully validate their business models until they have scale.

While Facebook, YouTube, and Twitter lacked an initial theory about how to make money, other platforms may have such a theory but nevertheless choose to defer monetization for strategic reasons. Due to network effects, the value of a platform increases with the scale of its user base. It often makes sense for platform owners to offer their service free of charge in order to amass a bigger user base. PayPal, for example, did not introduce fees until after it became the dominant online auction payment service.43
Appendix F: Using Lean Startup Methods in Resource-rich New Ventures

In this note’s introduction, we identify an initial lack of resources as one of the defining attributes of a startup. But not all new ventures initially face severe resource constraints. On rare occasions, startups are born “fat”: upon founding, they raise huge rounds of venture capital. Other new ventures are spawned within deep-pocketed large corporations. In theory, resource-rich new ventures—both fat startups and units of established corporations—should embrace a hypothesis-driven approach. Doing so will speed their time to market and improve the odds that their new products meet customer needs. In practice, however, it can be more difficult for such ventures to stick to lean startup discipline.

“Fat” startups     Research suggests that fat startups are prone to overspending. Eisenmann, for example, showed that during the late 1990s dot-com boom, Internet startups that raised substantially more capital than otherwise similar peers earned lower returns than those peers.44 We can speculate why it is difficult for fat startups’ founders to follow lean startup precepts. Firms that raise big initial venture capital rounds are often funded during valuation bubbles, when investors typically favor ventures that show strong growth in their user bases or revenues, rather than profits. This puts pressure on fat startups to scale prematurely, which in turn can lead to wasteful spending on product development and marketing while the startup is still pivoting toward product-market fit.

Corporate ventures     Recognizing the potential benefits of lean startup methods, Intuit and some other large corporations have been training their managers to use them.45 However, new ventures nested inside big companies often find it difficult to follow lean startup principles due to the nature of their budgeting and product planning processes. In most large corporations, managers crave predictability. Stage-gate planning, which delivers predictable results for incremental product line extensions, is often imposed on innovative new products for which it is less well suited. Stage-gate planning means that work is completed in big batches, which raises the stakes with each new round of product development. Due to escalation of commitment, a new venture can become too big to fail.

Likewise, innovative new products are usually funded through the calendar rhythms of an annual budgeting process designed to promote predictability in the core business. Managers submit new product proposals once a year; they ask for enough funding to cover a year’s worth of expected expenditures. Expectations for predictability make it awkward for managers to diverge from plan, so they may keep a zombie venture alive, awaiting yearend review by superiors, even after hypothesis testing has shown that the concept should be abandoned.
References


3 Ries, The Lean Startup, p. 57.


5 Ries, The Lean Startup, p. 22.


7 Ries, The Lean Startup, p. 108.


10 For a discussion of the differences between early adopters and mainstream customers, see Geoffrey Moore, Crossing the Chasm (New York: Harper, 2002).


16 Livingston, “Max Levchin, PayPal.”


19 For an overview of cognitive biases, see Daniel Kahneman, Thinking, Fast and Slow (New York: Farrar Straus, 2011).

20 Kahneman, Thinking, Fast and Slow, p. 256.

21 Kahneman, Thinking, Fast and Slow, p. 256.

22 Kahneman, Thinking, Fast and Slow, p. 257.

23 Kahneman, Thinking, Fast and Slow, pp. 264–265.


29 The principles of stage-gate planning are explained in Robert Cooper, Winning at New Products (New York: Basic Books, 2001).


31 Marmer et al., “Startup Genome Project Extra on Premature Scaling.”

32 For an overview of research on innovation, see Scott Berkun, The Myths of Innovation (Sebastopol, CA: O’Reilly Media, 2010).

33 In addition to the books on design thinking cited above, see IDEO founder Tim Kelley, The Art of Innovation (New York: Doubleday, 2001).

34 See Ries, The Lean Startup, pp. 97–99; and Eisenmann, Pao, and Barley, “Dropbox: It Just Works.”


39 Eisenmann, Pao, and Barley, “Dropbox: It Just Works.”


43 Jackson, The PayPal Wars.


45 Ries, The Lean Startup, pp. 32–36; 88–89.