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Lean startup and the business model: Experimentation revisited☆

Teppo Felin[a,*], Alfonso Gambardella[b], Scott Stern[c], Todd Zenger[d]

[a] Saïd Business School, University of Oxford, Oxford, UK
[b] Bocconi University, Department of Management & Technology and ICRIOS, Milan, Italy
[c] MIT Sloan School, USA
[d] David Eccles School of Business, University of Utah, Salt Lake City, UT, USA

Introduction

Entrepreneurs are increasingly viewed by practitioners and scholars alike as actors engaged in quasi-scientific experimentation (Camuffo et al., 2019; Felin and Zenger, 2009, 2017; Gans et al., 2019; Ries, 2011; Osterwalder and Pigneur, 2010). Entrepreneurs generate unique theories and models about how to create value, and then craft experiments to test their hypotheses. Perhaps the most widely-diffused practitioner approach that adopts the entrepreneur-as-scientist model is "lean startup" and its related tool, the business model canvas. Lean startup and the business model canvas have become key curricular foundations for entrepreneurship classes, programs and incubators.[1] And books like *The Lean Startup* (Ries, 2011), *Business Model Generation* (Osterwalder and Pigneur, 2010), *The Startup Owner's Manual* (Blank and Dorf, 2012)—as well as associated practitioner articles (e.g., Blank, 2013; Eisenmann et al., 2012)—are widely adopted in classrooms and entrepreneurship centers throughout the world.[2]

The attraction of the lean startup approach is clear. It seeks to offer a "scientific approach to the creation of startups" (Ries, 2011; also see Blank, 2013), pushing entrepreneurs and innovators to undertake structured experiments based on an underlying hypothesis, and incorporating feedback from these experiments directly into a process of rapid iteration and innovation. Lean startup has also introduced a common vocabulary for discussing startup activity, and has provided a number of useful tools and concepts, including the business model canvas, the minimum viable product, customer development and validation, and pivoting.

In this essay we discuss and critique the assumptions behind lean startup, specifically *how* the approach conceives of hypothesis development and startup experimentation. While the scientific ethos of the approach is certainly to be applauded, we argue that the prescriptions suggested by lean startup feature challenges and unintended consequences. In short, we claim that the approach's heavy emphasis on readily observable feedback and immediately validated learning undersells the entrepreneurial scientist's central task of composing a novel theory and hypotheses, prompting instead a search for value and validation only where it is easy to observe it. Thus we argue that lean startup inadvertently mis-specifies the nature of hypothesis development and promotes incremental experiments that, more often than not, only generate incremental value. Furthermore, the favored hypothesis-generating tool of lean

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* Corresponding author.
E-mail addresses: teppo.felin@sbs.ox.ac.uk (T. Felin), gambardella@unibocconi.it (A. Gambardella), sstern@mit.edu (S. Stern), todd.zenger@utah.edu (T. Zenger).

[1] The "lean launchpad" methodology provides the intellectual foundation for many university-based entrepreneurship centers and incubators. Large-scale initiatives using the lean startup approach (or lean launchpad) are ongoing at a number of world-class institutions, including UC Berkeley, UCSD, Columbia University, Stanford, and Oxford. Lean startup is also the curriculum for the National Science Foundation's Innovation program (called Innovation Corp, NIH also has a similar program), which seeks to help scientists and engineers launch startups and commercialize their intellectual property (Blank, 2011). Even universities without business schools have prominently featured lean startup and business model canvas content in their engineering or computer science curriculum, or as part of their newly-formed centers of entrepreneurship (e.g., Brown, Princeton).

[2] As highlighted by the extensive co-citations, the business model canvas is closely linked to the academic concept of a business model (Chesbrough, 2010; Massa et al., 2017; Osterwalder et al., 2005; Wirtz et al., 2016; ZottAmit and Massa, 2011).

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startup—the business model canvas—lacks specificity in helping startups craft unique, targeted hypotheses and critical experiments for testing their theories. After considering these challenges with lean startup, we offer the outlines of an amended and alternative approach to startup science and experimentation.

Lean startup: Challenges and unintended consequences

Challenge #1: Applying lean manufacturing to startups

The concept of "lean"—which is the centerpiece of the "lean startup" approach—has its origins in manufacturing, operations, and the total quality movement. The lean method received widespread global attention with the publication of Womack et al., 1990 book *The Machine That Changed the World*. The book focuses on Toyota's lean production system and how the company used various lean techniques and tools to continuously improve and revolutionize quality (cf. Deming, 1982). During the subsequent decades, the lean approach has become a central foundation for much of operations research (Shah and Ward, 2003). The approach seeks to address a series of key "operational" issues, such as inventory management (just-in-time), waste reduction, the optimization of supply chains, and continuous improvement in manufacturing (for a genealogy of lean production, see Holweg, 2007). The principles of lean manufacturing were also essential to the total quality movement that swept across the globe in the 1980s and 1990s (Powell, 1995; Zbaracki, 1998).

The lean *startup* movement explicitly builds on these lean manufacturing principles. As argued by one of the founders of lean startup, the approach is "the application of lean thinking to the process of innovation" and startup activity (Ries, 2011: 6; also see Blank, 2013).[3] It is based on the belief that "the theory that is the foundation of Toyota's success can be used to dramatically improve the speed at which startups find validated learning" (Ries, 2011: 188). Advocates of the lean startup approach argue that traditional management research offers "far too little theory to guide the actions of leaders" and provides no real application to startups (Blank, 2013). Lean startup, then, ambitiously claims to offer a "comprehensive theory of entrepreneurship" (Ries, 2011).

The principles of lean—waste reduction, quality management, continuous product improvement and learning—have certainly been important in the context of *manufacturing* and incremental product innovation. However, their worth is oversold in the context of startups and entrepreneurship. The lean startup approach argues that implementing lean will lead to "radically successful businesses" and startups (Blank, 2013). But the central challenge is that lean production techniques were explicitly developed for *continuous* and *incremental* improvement of *existing* processes and products (Womack et al., 1990; cf. Bicheno and Holweg, 2015). This creates a mismatch, as startups, particularly those that create significant value, seek to compose radically *dis*continuous innovations and *new* products rather than merely hoping for incremental improvements. Arguably, the biggest problems of early stage startups—again, if they truly hope to create novel products or originate new industries—have little if anything to do with the problems that lean production actually seeks to solve. This issue is most glaring if we look at the actual outcomes that lean methods yield for established companies that have used the approach, as highlighted by existing research (e.g., Bhamu and Sangwan, 2014; Holweg, 2007; Shah and Ward, 2007; cf. Zbaracki, 1998). The lean methods applied to manufacturing do indeed result in continuous improvement in supply chains, error and waste reduction, and much-improved quality and more reliable products (Danese et al., 2018). But what they tend to *not* generate are radically new products or discontinuities, even for companies like Toyota that pioneered the approach. Lean wasn't designed for radical innovation. Thus, the tools—and overall ethos and spirit—of lean manufacturing appear rather incongruent with the outcomes that are promised to startups who adopt the approach.

Challenge #2: Experimentation and customer validation

Now, the lean startup approach of course hasn't applied lean manufacturing on a one-to-one basis. Rather, it has adapted lean manufacturing principles to the startup setting in specific ways.

Lean startup places a particularly strong emphasis on experimentation and the scientific validation of hypotheses through *customer interaction*. It places less emphasis on hypothesis development itself—a bias perhaps derived from the belief that a "hypothesis is just a fancy word for *guess*" (Blank and Dorf, 2012: 37; also see Ries, 2011). For this reason, lean startup tells founders to stop spending time planning or theorizing and to get out of the proverbial office to talk with, listen to, and interact with customers. Rather than waste time planning, startups should quickly develop a "minimum viable product" and get rapid customer feedback and input.[4] Business plans are actively discouraged by the lean startup approach, because "business plans fail on contact with customers" (Blank, 2013; cf. Blank and Dorf, 2012). Instead, founders and managers are told to interact with potential customers as soon as possible, to iterate and learn from them. The central logic is that customer interaction is what elevates startup hypotheses from the realm of guesses to the realm of facts and data (encouraging learning and pivots), thereby rendering startup activity more scientific and evidence-based (Blank and Dorf, 2012: 37).

It's hard to disagree with the importance of focusing on customers. After all, whether customers eventually buy a product represents the ultimate market test. But the question is, precisely *when* (and for what types of products) does engaging with customers

[3] Furthermore, as noted by Ries: "Lean Startup takes its name from the lean manufacturing revolution that Taiichi Ohno and Shigeo Shingo are credited with developing at Toyota" (2011: 18).

[4] While lean manufacturing placed some emphasis on customer interaction, this certainly wasn't a primary emphasis (see Womack et al., 1990: 169-191; cf. Holweg and Pil, 2005).

make sense? Should companies engage with customers in the very early origination and *development* of products (and in some sense, in the development of a startup's strategy)—using a minimum viable product? And does this customer interaction indeed provide a useful, reliable, intermediate signal and tool for learning and creating radically new products? In some cases, yes. But we believe the case for customer feedback as the entrepreneurial scientist's panacea is overstated. In many cases it's not clear why customers would have a better sense of the viability of some future product, compared to startup founders themselves. Nor is it clear why observing or surveying customers would help startups learn and generate *radically* new products.[5]

The eagerness to get customer feedback assumes that customers know what they might want in the future. Again, this might be true in some situations, particularly in cases of incremental innovation. But as quipped by Steve Jobs, "it isn't the consumers' job to know what they want." This is the reason Apple has historically shied away from the type of customer interaction suggested by lean startup, relying instead on the judgment of key employees who share a common vision of the future they wish to generate. The problem is that customer imagination is delimited by what is presently there or what is presented to them. As captured by Henry Ford, "if I'd asked customers what they wanted, they would have told me, 'a faster horse'!" Startup founders need to, in some sense, look beyond the present and into some unknown future—beyond existing products and realities. Thus there is a gap in whatever informational signals and validation that might be available from interacting with and surveying customers—and the future.[6] And it is specifically the role of strategy or entrepreneurship to fill this gap.

Lean startup's reliance on external signals, customer feedback and validated learning misses a very large academic literature on just how troubled the concepts of experience and learning are (e.g., AnandMulotte and Ren, 2016; Felin and Foss, 2011; Levinthal and March 1993).[7] The specific problem is that available feedback from an environment can teach firms (startups included) the wrong lessons, and lead to myopia and traps. Learning is only as good as the startup's (or anyone's) ability to sense what they should be looking for and experiencing in the first place. This is partially recognized in lean startup (Ries, 2011: 276, "having a theory allows [one]…to predict what will happen"). But no tools, beyond the category mapping of the business model canvas, which we discuss below, are provided for developing this underlying theory; again, a reality that may simply reflect the lean startup belief that theories are little more than guesses (Blank and Dorf, 2012). Startups need to have a mechanism through which to filter environmental information and lessons—a theory that helps them know what data and observations are most relevant (Felin and Zenger, 2009). The encouragement to go-out-and-act, instead of planning, can only lead to relatively short-sighted trial-and-learning and pivoting, without any kind of commitment or theoretical anchor. Thus startups need tools for understanding what information and data they should be sampling and using as the basis of their validation and learning in the first place (cf. Le Mens et al., 2018).

It is notable that even highly efficient capital markets and other external audiences have difficulty assessing the value of what is novel and new (Zuckerman, 1999). The more novel a strategy, the more likely the discounting of that strategy by public markets and extant evaluators of value (Benner and Zenger, 2016). And the same, arguably, can go for customers. The environment then does not somehow offer "free" lessons or signals for startups or companies. Public markets, like customers, are poor assessors and evaluators of novel strategies. Environmental signals may in fact lead strategists, startups and firms astray.

Challenge #3: Canvas, business models and experimentation

Lean startup features a popular tool, called the business model canvas, which has become an important framework in entrepreneurship classes and startup mentoring. The tool is meant to be a practical aid to enable startups to "sketch their hypotheses" and "search for a business model" (Blank, 2013; also see Osterwalder and Pigneur, 2010). The canvas features nine distinct boxes to fill in: key partners, key activities, key resources, value propositions, customer relationships, channels, customer segments, cost structure, and revenue streams (Osterwalder and Pigneur, 2010; also see Chesbrough, 2010; Osterwalder et al., 2005). The hope is that by addressing the nine elements of the canvas that valuable hypotheses will emerge, "hypotheses that [then] need to be tested" (Blank, 2013).

In some sense the canvas provides a compelling list of potential business model elements that merit consideration for a startup. But from our perspective, the necessary initial step is not to broadly canvas the environment in search of a full-fledged business model, but rather to develop a unique and potentially valuable hypothesis, built around an entrepreneur's unique beliefs and coherent theory of value. This theoretical hypothesis development must be more than a mere guess. Rather, as in science, hypotheses originate and derive from sound theoretical logic, which at its best provides guidance for what to look for in the first place (cf. Popper, 1967). In short, the entrepreneurial exercise should begin by deciding what to look for, rather than cataloging what you see. As we discuss in the next section, theories of value are what focus entrepreneurial attention on key elements, rather than, in effect, attempting to

[5] The canonical example from the disk drive industry highlights how listening to customers in fact *led* to the disruption of the then market leader, Seagate Technology (cf. Christensen, 1997). And the story is quite a bit more nuanced than even suggested by Christensen. That is, certain employees within Seagate—for example, Finis Conner—foresaw the disruption and in fact created the very startup that disrupted the industry, Conner Peripherals (Felin and Zenger, 2017: 266). Thus the various customer tools suggested by lean startup might indeed be useful for *incremental* feature and product improvements—which indeed is the basis of lean manufacturing—but not for disruptive ones.

[6] As put by inventor and Polaroid Corporation co-founder Edwin Land: "every significant invention must be startling, unexpected, and must come into a world that is not prepared for it. If the world were prepared for it, it would not be much of an invention."

[7] Contigiani and Levinthal (2019) have also recently discussed the deeper (though unrecognized) academic links between lean startup and key academic literatures. They specifically argue that the lean startup insights have already been anticipated and more carefully developed in a host of academic literatures, including the literature on organizational learning and feedback, real options theory, the technology evolution literature, and the product development literature.

describe all of reality.

The business model canvas might be seen as the metaphorical equivalent of trying to create a map of reality on a 1:1 scale—an effort to map everything (or many things), but without any clear sense of what the canvas is a map *of*. But, as the famous quip suggests, "the map is not the territory."[8] That is, a map's value lies precisely in its capacity to expedite the process of getting toward some end state (which in the case of startups necessarily needs to be unique). Ironically, the more detail that a representation or map has, the less useful it becomes, especially in providing initial, high-level and unique strategic guidance about what to do. Maps—like strategies and theories (Felin and Zenger, 2017; Van den Steen, 2017)—are useful when they abstract away from the details and provide clear guidance about what (and how) the startup should represent its beliefs and theory, and what founders then should *look for* in the environment. And most importantly, representations, entrepreneurial beliefs and theories, need to be startup-specific: uniquely designed to startups or firms themselves. They scarcely originate from customers or other outside actors. Thus our concern is that the business model canvas lacks an *ex ante* mechanism or tool for originating unique hypotheses in the first place. Instead it implicitly counts on some form of uniqueness emerging from the process of filling out the nine hboxes in the canvas, and the subsequent testing, interaction and learning through customers (Blank, 2013).

The problems of lean startup's business model canvas broadly mirror some of the problems in the academic literature on business models.[9] The specific problem in the business model literature is that "definitions abound, and many of those definitions lack specificity" (Foss and Saebi, 2017: 209; cf. Teece, 2010). Definitions of business models are broad and heterogeneous, and often demand too much detail to be actionable or useful. For example, Smith et al. define business models as "the design by which an organization converts a given set of strategic choices—about markets, customers, value propositions—into value, and uses a particular organizational architecture—of people, competencies, processes, culture and measurement systems—in order to create and capture this value" (2010: 450). Recent reviews of business model definitions highlight just how all-encompassing the business model concept is. Existing definitions of business model mention everything from "customers" to "employees" to "cognition" to "transactions" to "interconnected activities" to "resources" to "capabilities" to "technology" to "architecture" and "interdependencies" to "stakeholders" and "suppliers" to "structure," "governance," "incentives," "networks," and so forth (Massa et al., 2017; Wirtz et al., 2016; ZottAmit and Massa, 2011).

Now, there's no question that many of the above issues covered by the business model concept (as well as the canvas) are important. No one thinks that stakeholders are *un*important, nor that there aren't important interdependencies amongst many of these factors, or that customers don't matter.[10] But none of this meaningfully provides startups with specific guidance about the firm's own unique strategy, commitment, and point of view. Thus a well-developed business model might instead be thought about as an aspirational ending point, and not a starting point for generating hypotheses or experiments. Walking through the nine business model elements does not provide the basis for a useful map, or the basis for a unique or useful strategy or theory. While vision, strategy and theory are mentioned throughout the lean startup literature, and in conjunction with business models, unfortunately hypotheses are given secondary status (given the eagerness to quickly experiment), and firm-specific tools or intuition are often missing. This means that founders and startups filling out the business model canvas and interacting with customers are likely to mistake this activity with the more fundamental issue and first-order problem of actually crafting and designing a unique theory of value from which a hypothesis and associated experiments can be derived.

Startup strategy: Theory and commitment

From the perspective of startup strategy, we view the central limitation of lean startup as its tendency to orient entrepreneurs toward ideas and products that can *quickly* and transparently be tested with customers. In this sense lean startup is the metaphorical equivalent of a prompt to look for your keys under the streetlight (Kaplan, 1964). Namely, lean startup prompts low-cost startup ideas or search where the experimental "light" is: where beta products can be rapidly developed, and where customers and investors can already easily understand and agree (or disagree) with what a startup is doing. But the problem is that the resultant products and opportunities are more likely to be incremental, and importantly, also obvious to other potential entrepreneurs and innovators. Furthermore, any customer signal will likely lead startups to pivot toward more incremental and obvious opportunities.

The most valuable entrepreneurial ideas are those that are *un*likely to permit an easy, immediately-recognizable experiment (Camuffo et al., 2019; Felin and Zenger, 2017).[11] They require some kind of contrarian belief, vision about and commitment toward a counterfactual world that may not easily be recognizable by other market actors (cf. Van den Steen, 2017). Thus the most valuable entrepreneurial ideas demand carefully formulating the underlying problem the startup is seeking to solve, developing a theory of how to solve it, and only then crafting what may often be a costly set of experiments to test and explore the underlying theory. Thus,

[8] Here we are amending philosopher Alfred Korzybski (1958) famous quip: "the map is not the territory." Map-territory relations highlight the need for parsimony in theory and science, which is further discussed by philosophers of science (e.g., Nagel, 1961).

[9] The business model canvas (originally developed under the label "business model ontology," see Osterwalder, 2004; Osterwalder et al., 2005) and business model literature have close links (Chesbrough, 2010; Massa et al., 2017). Most conceptions of business models argue that there is a need to consider the broader set of constituents (beyond the firm) in the value creation process, including suppliers, customers and other stakeholders, as well as factors such as resources, transactions and costs, and so forth. Of course, the list of key considerations when it comes to business models (whether nine or some other number) differs widely across definitions (see Massa et al., 2017).

[10] The same might be said of business model-related concepts such as ecosystems (Jacobides et al., 2018), which heavily focus on environmental interdependencies and multilateral linkages to external stakeholders.

[11] It's worth recognizing that a focus on economic experimentation is scarcely new (see Rosenberg, 1992; Stern, 2006).

impactful startup activity often requires a significant commitment toward a specific course of action, rather than a set of low-cost experiments and pivots (Gans et al., 2019; cf. Bennett and Chatterji, 2017). And importantly, it is the choice and pursuit of this theory—which also forecloses other options (or pivots)—that reveals the further information, experiments, and insight needed to further refine the startup theory.

Of course, whether one focuses on low-cost experiments and pivots versus significant commitments and path-dependent development depends on the outcomes one is seeking. As we've discussed, the low-cost experimentation suggested by lean undoubtedly can play a role in some contexts and be useful for incremental innovation for certain types of existing products. But if a startup is truly seeking to "disrupt" an industry or create radical innovations, then the choice of the initial path and initial experiment is absolutely critical—and therefore can't be relegated to a guess or subsequent pivots. This is because the probability of starting elsewhere and arriving at this same path through sequential pivots is highly unlikely.

To illustrate the importance of commitment and theories, we might amend the aforementioned lamppost-search metaphor and argue that having a theory, and committing to a course of action, is the equivalent of using a flashlight which allows startups to look for solutions to problems, guided by a theory, in places that are hidden and not obvious to others.[12] This perhaps also solves the factor markets problem where all strategically-useful assets are already priced to their best use (Barney, 1986), or where their accumulation is merely a function of guesswork and luck (Denrell et al. 2003). Theories illuminate and tell us where and what to look for in the first place, where to find value (Felin and Zenger, 2017). They *reveal* data and experiments unobservable to others. This resonates with Einstein's observation that: "whether you can observe a thing or not depends on the theory which you use. It is the theory which decides what can be observed" (Polanyi, 1974: 64).[13] The same intuition applies to startups and the theories of value that they develop.

Our point is not to undermine the power of well-crafted experiments, nor is it to suggest that vast time spent composing theories in some entrepreneurial ivory tower is a fruitful path. Rather, our point is that a well-composed theory elevates the nature and impact of experiments—enabling the composition of *critical* experiments, experiments that permit unique and clearer conclusions about a startup theory's merits. Paradoxically, the end result may be faster pivots and, above all, more productive ones. Indeed, this is one of the conclusions to be drawn from Camuffo et al. (2019) randomized control trials of startup activity, examining the influence of pushing entrepreneurs to operate like theory-driven scientists. Their findings show that those entrepreneurs who were taught to carefully frame their problems, formulate falsifiable hypotheses, and compose rigorous experiments (before taking up lean startup) appear more likely to both avoid false positives—pursuing bad venture ideas longer than they should, and avoid false negatives—and pursue instead venture ideas that are actually promising. Their study provides initial evidence for the claim that entrepreneurs armed with more well-developed theories create more value; or they exit or pivot more quickly when their ideas are unprofitable.

This "supply-side" approach to startups, implied by our arguments, suggests that there are alternative or intermediate validation tools that don't necessarily involve customer judgment. Again, customers of course are the ultimate test of whether something is valuable. But listening to them prematurely—before a compelling theory of value is formed and testable hypotheses derived—may lead startups astray, or toward incremental value. Instead of quickly focusing on low-cost minimum viable products, and customer feedback, startup founders may find *social proofs* a particularly important signal of value. Social proofs emerge from a capacity to persuasively convey a possible future contrary to existing facts and to draw people to join in the production and pursuit of a particular economic theory and opportunity. Startups and nascent organizations can in some sense be seen as a social proof of viability or possibility associated with a belief, hypothesis and theory of a future reality. Here the experiment is whether a founder can persuade others of their theory, problem framing and assumptions, sufficient for them to perhaps quit lucrative jobs at established companies and join the startup. Beliefs and hypotheses can thus be informally (though not conclusively) validated by *who* decides to join a particular startup (again, perhaps leaving high-paying jobs elsewhere), thus signalling a joint commitment to realize a particular theory. Funding sources might also provide a similar signal of viabilityan intermediate form of social proof or validationfor what to others might appear overly risky or implausible futures. Funding a startup can essentially be seen as a vote for the viability and potential of a startup's theory. If the imagined value is obvious to everyone (or the signal is readily garnered through customers), then the information is likely to be widely diffused, and no above-normal rents are available. Again, public markets are poor at assessing truly novel strategies (Zuckerman, 1999), and therefore alternative forms of validation and funding are needed. The mechanism of self-selection (into and out of organizations) then is a powerful tool for not only assessing the prospects of organizations in decline (cf. Hirschman, 1970), but also the viability and potential of nascent organizations and startups.

Conclusion

There are many virtues to the lean startup approach. It has broadly pushed entrepreneurial activity to be more scientific and experimentation-oriented, which, when deployed appropriately, certainly is a welcome direction. However, the lean startup approach has limitations. For example, the emphasis placed on lean tools from manufacturing—which inherently lead to incremental innovation (Holweg, 2007; Womack et al., 1990)—necessarily offers less useful guidance for startups trying to create radically new products and markets. Thus the contingencies for when to use minimum viable products and customer validation, and when not, deserve further

[12] Research in the cognitive sciences provides support for this point, namely, the role that theories play in guiding our awareness and attention toward potentially novel attributes or features of the environment. For a recent discussion of this literature, see Chater et al. (2018).

[13] As put by Popper, "observation comes after expectation or hypothesis." Thus getting the hypothesis right is of critical importance. Learning then essentially happens *before* experimentation: as put by Popper, "we learn only from our hypotheses what kind of observations we ought to make: whereto we ought to direct our attention: wherein to take interest" (1967: 346).

attention. Furthermore, the argument that hypotheses merely are a "fancy word for a guess" (Blank and Dorf, 2012) mis-specifies the nature of theory and the guidance that it can provide to startup founders and strategists. Thus we point to alternative streams of research in strategy and entrepreneurship (e.g., Camuffo et al., 2019; Felin and Zenger, 2009, 2017; Foss et al., 2018; Gans et al., 2017; Gavetti and Menon, 2016; Van den Steen, 2017), which emphasize the role of beliefs and commitment, theories and problem-solving and the guidance that these can offer in entrepreneurial experimentation and strategy. The approaches suggested here are not necessarily opposed to lean startup. However, we do think they suggest some critical amendments and new directions to the startup and entrepreneurship literature (and practice), as well as offering opportunities for future research. For example, the links between commitment, theories, problem-solving and experimentation deserve further attention. And the most suitable and effective approach—whether experimentation with minimum viable products or larger scale commitments and theories—is likely to be contingent on technology, industry and other factors. Attention on these contingencies provides a significant opportunity for future work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.lrp.2019.06.002.

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