ROUTINES OF NEW VENTURE CONCEPTUALIZATION: EVIDENCE AND EXTENSION OF AN ENTREPRENEURIAL DYNAMIC CAPABILITY

by

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Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Weatherhead School of Management
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CASE WESTERN RESERVE UNIVERSITY

May 2016
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Routines of New Venture Conceptualization: Evidence and Extension of an Entrepreneurial Dynamic Capability

Abstract

by

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A dynamic capability consists of routines to reconfigure resources to improve venture performance in a rapidly changing marketplace. Entrepreneurs adopt different routines to collect and interpret new information during the design of a venture concept. One such routine entails generating and testing hypotheses of a business model. This five-phase research stream employs sequential mixed methods to analyze the efficacy, antecedent, and boundary conditions of an entrepreneurial dynamic capability within a cleantech accelerator program.

Overall, the study finds mixed support for contemporary routines of venture conceptualization. Teams that validate hypotheses create ventures that perform better. However, a larger number of validated hypotheses does not result in significantly better venture performance. Simple use of the Business Model Canvas does not improve venture success. However, validation of hypotheses simultaneously across a group of key elements – customer segmentation, value proposition and channels – does improve performance. Flexible customer conversations generate more success as a mechanism to collect evidence during hypothesis testing than formal experiments. Yet, contrary to extant literature, these two activities are not always complementary; in this sample, they are substitutive in that the use of both activities reduces the likelihood of success. Only the trait of conscientiousness within the leader of an entrepreneurial team is a
significant microfoundational antecedent to its use of experiments. None of the other Big Five traits or a predilection for improvisation is a significant antecedent, implying that these routines are available to any type of entrepreneur.

Practicing entrepreneurs adopt an alternative framework for a business model, incorporating the intended customers’ pre-existing habits, mental models and product constellations, thereby embedding the resulting venture more deeply into the context of the marketplace.

An amended routine during conceptualization focusing on customer conversations to validate hypotheses within a few portions of the business model forms an entrepreneurial dynamic capability that improves the likelihood of eventual venture success. Additional research would resolve some of the limitations of this research stream and further bridge the literature of entrepreneurship and corporate strategy.
Biography

Ted Ladd is currently a professor of internet economics at the Hult International Business School, teaching entrepreneurship to graduates students in San Francisco, Seattle and Copenhagen. He holds a master’s degree in business administration from the Wharton Business School, a master’s in international economics from Johns Hopkins University, a bachelor’s degree as a triple major in biology, sociology and government from Cornell University, and a certificate from the Oklahoma School of Horseshoeing. His professional experience includes several startups in mobile and cleantech technologies. The most recent was purchased by Google to form the foundation of its smartwatch software. He and his wife, Laura, live in Jackson Hole, Wyoming.

Acknowledgements

To my Case classmates, professors and advisors for intellectual rigor and non-intellectual hilarity. Especially to Kalle (last name irrelevant) for responsive, voluminous, patient and insightful feedback.

To my students and business colleagues for motivating the research.

And to my wife for encouraging this adventure.
CHAPTER 1: INTRODUCTION

Many startup ventures fail. Despite the massive amounts of time and money spent by entrepreneurs, investors, and communities into the creation and launch of new businesses, a majority do not attract customers and therefore do not generate sufficient revenue to cover costs (ISBDC, 2015). There are many possible explanations for these failures, from issues with the business environment to processes around financing and execution, including relationships between founders, investors, employees, customers, and supplier. This research, however, is focused exclusively on the process by which founders refine their nascent venture’s business model. Many startup failures might be attenuated if not eliminated with a small investment of time (and almost no money) long before the venture is launched by forming and testing hypotheses about the potential venture’s business model via direct interaction with the customer (Ries, 2011). Absence of hypothesis testing may result in venture failure from misaligned, inefficient, or faulty and middle-of-the-road business models (Zott & Amit, 2007). However, to what extent these claims are true has not been studied in the emerging literature around business venturing.

A business model is an explicit description of the logic by which the firm creates and captures value (Morris, Schindehutte, & Allen, 2005). In its initial stages, the business model forms a collection of untested assumptions about the content and structure of a firm’s activities and transactions (Zott & Amit, 2010). One popular framework for defining a business model is the Business Model Canvas (Osterwalder & Pigneur, 2010), which contains nine individual elements, each with its own hypotheses. The conceptualization process involves the application of evidence to test these
assumptions (Blank, 2006), along with iterations to the business model that constrain it to what is possible to effectuate (Sarasvathy, 2001, 2008).

Business model validation through hypothesis testing can be seen as an emergent and repeatable routine that guides entrepreneurs as they collect, interpret and absorb new information, and reconfigure resources that are likely to improve the chances of venture success. These learning routines are called dynamic capabilities (Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997) in that they help a firm constantly configure and change the capacities and resources that the business venture needs to succeed. Such capabilities have been studied extensively within the literature of corporate strategy as one explanation for how firms can pursue sustainable competitive advantage. Hypothesis generation and testing in this context have explicitly been heralded as a dynamic capability to sense and seize new business opportunities (Teece, 2007). In a real venturing setting, these routines can be traced to the specific characteristics, interactions, and activities carried out by individuals. Such individual behaviors and related traits are therefore called microfoundations of dynamic capabilities (Eisenhardt, Furr, & Bingham, 2010; Teece, 2007). However, the literature on this research stream has not been widely applied to the processes or people who engage in nascent business venturing.

This dissertation revolves around an examination of hypothesis testing as a process whereby entrepreneurs refine and validate their business concepts prior to launching a new venture. This process occurs after the entrepreneur has declared an intention to start a business and honed in on a specific sector, but before the entrepreneur offers a product or service to paying customers. My research asks how hypothesis testing of the venture’s proposed business model improves the likelihood of eventual venture
success. In other words, is hypothesis testing an effective entrepreneurial dynamic capability? If so, under what conditions?

This broad question is divided into specific questions that motivate individual pieces of this research. First, I ask if business model validation is a driver of eventual venture success. As a related question, I explore if all aspects of the business model are equally important during hypothesis validation, or if some elements are more important to nascent ventures. Second, I examine one of the key steps of hypothesis testing, which is the collection of salient evidence. I ask if conversations or experiments with potential customers are more or less useful activities to gather such evidence.

These activities involve interactions and interpretations, which therefore engage the entrepreneur’s cognitive inner traits and related behaviors. In the third part of this study, I ask how personality and a predilection for improvisation impact the entrepreneur’s likelihood of using either of these evidence-collecting activities. These antecedents may be embedded within the individual, thus forming a microfoundation to the dynamic capability. Finally, I ask how practicing cleantech entrepreneurs envision the business logic that drives their business success in real contexts. How do they define their own business models, and how does this differ from the normative frameworks offered in extant literature?

To explore these questions, this dissertation relies upon a mixed method research design that integrates qualitative and quantitative data to triangulate findings and develop theoretical insights. The intention behind this design is to provide additional reliability and validity to the conclusions (Morse, 2010). In line with this goal, the dissertation contains four separate but interrelated research papers, which are defined as phases.
within the stream of mixed method research. Each addresses some of the specific research questions above. This paper summarizes and integrates the findings of these four papers to address our over-arching question stated above.

The evidence to explore the research questions originates from entrepreneurs who innovate with new technologies to generate low-carbon energy solutions ("cleantech"), typically for customers in impoverished regions at the base of the world’s economic pyramid. Three of the four phases of this research revolve around participants of a cleantech accelerator program where several hundred teams yearly construct new business ideas during a three-month period. At the end of each year’s program, each team pitches its venture concept to a panel of expert judges, who award substantial prizes to the winners to support their commercial launch. Reception of these awards is an objective (albeit imperfect) proxy for venture performance in two of our four studies. The fourth phase of this research solicits opinions about business models from practicing cleantech entrepreneurs.

The findings of these four phases are summarized as follows. Teams who conducted any hypothesis validation whatsoever performed more than twice as well in the competition as teams who performed no validation. However, there was no relation to the number of validated hypotheses and the team’s performance: more was not better. Moreover, no individual component of the business model was significant as a sole category for creating successful validated hypotheses. Teams that validated more hypotheses relating to targeted customer segment, value propositions, and channels performed better than teams that validated few hypotheses in each of these three components. This paper is included in Appendix A: Is Business Model Validation Valid?
Teams that engaged in customer interaction but not experimentation to construct and validate their business concepts increased their chance of winning an award by 50% when compared to those who did not conduct any customer conversations. On the other hand, teams that conducted experiments without customer interaction did not significantly improve their performance. Finally, teams that engaged in both activities performed worse than when they only focused on customer interaction, but better than if they did not engage in any customer interaction at all. It is included in this dissertation in Appendix B: How Customer Interaction and Experimentation Advance New Venture Concepts in a Cleantech Accelerator.

Conscientiousness was found to be a significant antecedent to the use of experimentation. Neither the other Big Five traits nor improvisation are relevant antecedents. This paper can be found in Appendix C: Personality Traits and Improvisation as Microfoundations of an Entrepreneurial Dynamic Capability.

Practicing entrepreneurs defined their own business models with components that diverged from the extant definition in the literature. They embedded their value-creating logic into the habits, mental models, and existing product constellation of their anticipated customers. This paper is included in Appendix D: Business Models at the Bottom of the Pyramid: Leveraging Context in Undeveloped Markets

From these four empirical studies, I conclude that validation of a nascent venture’s proposed business model through customer interaction is likely to improve its chance of success. The dynamic capability is available to entrepreneurs of any personality type; yet conscientious founders are more prone to experimentation. However, this validation is more impactful, if it focuses on a subset of the business model
with emphasis on elements that embedded the venture into its specific marketplace (Figure 1).

**Figure 1: Hypothesis Testing as an Entrepreneurial Dynamic Capability**

The remainder of this dissertation is organized as follows. The questions that motivate the research are described in detail. This is followed by an exploration of the pertinent literature on dynamic capabilities, business models, customer-focused evidence-gathering activities, and microfoundational entrepreneurial traits and behaviors. Each section within this literature review explains the gaps that remain unaddressed. Next, this paper describes how the research was designed to explore these questions. In the discussion section, the findings are enumerated and integrated into a single set of conclusions to address the research questions. Finally, in the conclusion, I describe the contributions that this research provides to entrepreneurs, teachers, and researchers, as well as its limitations and opportunities for future research. The four empirical papers that comprise these specific phases of this research are provided in appendices.
CHAPTER 2: STUDY GOALS AND RESEARCH QUESTIONS

The goal of this research stream is to examine the prevalence, efficacy, mechanism and antecedents of procedures that nascent entrepreneurs can follow as they construct a business model for a new venture. These repeatable routines can be apply to start-up conceptualization where customer demands are either opaque or transient to improve the likelihood that the subsequent venture will succeed.

Several authors have suggested one such routine: managers should explicitly attempt to construct and then test hypotheses (Eisenhardt & Martin, 2000; McGrath, 2010; McGrath & MacMillan, 1995; Platt, 1964; Teece, 2007). Despite its broad support with scientific and management practices, there is little empirical research to extend or adapt this suggestion in the realm of nascent entrepreneurship.

Research Question One: Is business model validation through hypothesis generation and testing a significant driver for venture success?

This research question contains two related but distinct topics. The first is the value of hypothesis testing in general. The second relates to the framework that defines a business model as a vehicle to create and capture value. The Business Model Canvas (Osterwalder & Pigneur, 2010) embodies the assertion that a business model can be divided into nine exhaustive non-overlapping elements. This framework was derived from extant literature but its explanatory and predictive power has not been empirically tested. Our aim is to determine if this framework explains or predicts the success of entrepreneurial ventures when used to categorize validated hypotheses.

Second, entrepreneurs conduct scanning and sensing activities to aggregate and articulate the demands of potential customers (Teece, 2007). These activities collect
evidence for hypothesis testing by encouraging the entrepreneur to seek multiple varying opinions and to incorporate some of them into the new venture’s core offering based on selection criteria from outside of the entrepreneur’s own preconceptions and biases.

Based on entrepreneurial literature, we focus on two such activities: customer interactions (primarily through conversations during interviews) and more formal experiments.

Research Question Two: How much is venture performance improved by the activities of customer interaction and experimentation?

These two activities require that the entrepreneur interact with customers in a realm where the entrepreneur is uncertain about the customer’s responses. Repeating these activities to accumulate more and better information requires the entrepreneur to interpret and then incorporate lessons from earlier interactions into subsequent iterations. These interactions and interpretations necessarily rely on the cognitive predispositions and predilections of the entrepreneur. These traits and behaviors exist independent from the entrepreneurial effort, and so may form a prerequisite and boundary condition for the findings of Research Question Two about impactful evidence-gathering activities. In other words, because evidence collection relies on an entrepreneur’s cognition, certain personality types may be more prone to conduct these activities.

My third research question explores these antecedent traits as exhibited by the leader of the entrepreneurial team. This research question has three motivations. First, it is an acknowledged gap in the literature (Felin, Foss, Heimeriks, & Madsen, 2012). Second, most studies of micro-foundational personality traits and behaviors within the entrepreneurship literature focus on outcomes: the connection of traits to entrepreneurial intention or venture success. Few studies explore the connection of traits to the activities
that entrepreneurs perform during venture conceptualization, regardless of outcome. Third, understanding any prerequisites for these activities can allow practicing entrepreneurs to construct teams of people with the necessary traits to leverage these activities.

*Research Question Three: What traits and practices precede and predict successful entrepreneurial activities?*

Our first question above inquired about the utility of an existing theory of business models, assuming that theory reflected existing entrepreneurial approaches. However, practicing entrepreneurs may have a different conceptualization of the important components and drivers of their business model that contradicts this theory.

*Research Question Four: How do practicing entrepreneurs envision the key aspects by which they create and capture value?*

By synthesizing the findings across all four of these questions, we can address our research goal of elucidating a repeatable routine by which nascent entrepreneurs can refine their business models in order to increase their likelihood of success.
CHAPTER 3: THEORY AND LITERATURE REVIEW

This chapter provides a review of four different bodies of relevant literature, noting gaps that inform my research questions. Table 1 depicts the theories that are relevant to each phases of our research. For example, theories around dynamic capabilities relate to the propositions explored within phases one, two, and three of this research stream, whereas the microfoundations of dynamic capabilities are only explored within phase three. The specific research studies within these phases are included in the appendices to this dissertation.

Table 1: Areas of Research by Dissertation Phase

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<th>Relevant theories</th>
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<td>1: Hypothesis Generation and Testing</td>
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<td>Business Models</td>
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<td>Personality Traits</td>
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The search for a repeatable routine for nascent entrepreneurs begins in the literature of dynamic capabilities within corporate strategy. In order to explain why some companies within an industry perform better than others—even though they are subjected to the same industry forces—Hamel and Prahalad (1990) asserted that the firm is an endowment of core competencies, comprised of both technologies and skills that differentially meet customer expectations. These competencies reflect the firm’s ability to integrate new information and processes into its organization. This theory, however, does not shed light on how one competency might generate superior returns over another.
Resource-Based View of the Firm

The Resource-Based View (RBV) of the firm was constructed to fill this gap by declaring that a firm’s long-term competitive advantage (and thus its above-average performance) emanates from the resources that it controls (Barney, 1986, 1991; Penrose, 1959; Wernerfelt, 1984). RBV describes why some competencies are better than others. These resources are defined more broadly than the traditional factors of land, labor, and capital to include tangible assets such as machinery and contracts and intangible assets such as brands, property rights, skills, processes, and culture (Wernerfelt, 1984).

The RBV framework rests on several assumptions (Peteraf, 1993) about the origins of above-average profitability of firms in a marketplace. First, firms within an industry have heterogeneous distributions of resources, where some resources are more efficient at production or more aligned with meeting customer demands. As a result, firms with these resources generate larger Ricardian profits than firms without these resources. In a fast-paced competitive marketplace, the difference in performance between these firms may not manifest as superior or inferior profitability, but instead as survival or failure.

Second, the profits from these superior resources must be durable; there must be ex post limits to competition such that the gains from a resource are not immediately competed away. This condition is met when the superior resources are difficult to imitate or substitute, perhaps because they are protected by property rights, informational asymmetries, causal ambiguity, or other isolating mechanisms (Rumelt, 1984, 1987). Some types of inimitability arise from path dependence. The resource’s evolution over time makes discovery and replication difficult (Dierickx & Cool, 1989; Nelson & Winter,
This inertia may also stem from long-term inflexibility of multiple possible factors of supply, which is a departure from neoclassical equilibrium models (Barney, 2001).

Third, resources are imperfectly mobile or “sticky”. Even if they can be excised and traded, the recipient firm would not find them as valuable as the original firm or the transaction cost of trading the resources would be prohibitive; they have non-recoverable switching costs. This feature may derive from a resource’s specialization to the original firm’s task, or its co-specialization with other firm resources (Teece, 1986). The profits (or Ricardian rents) from these resources are partially appropriated by the firm and partly by the factors that contribute to the resource (e.g. labor or capital). In other words, the firm captures at least part of the value that it creates. This appropriability is necessary for a firm to realize the economic benefit of its superior resources.

Fourth and finally, there are *ex ante* limits to competition. A firm cannot know for certain beforehand which resources will generate superior performance because such knowledge would be easily gleaned by competitors, resulting in bidding for the resource that would eliminate its profit potential. As a result, the selection of a resource by a firm produces both risk and cost (Barney, 1986).

In summary, resource heterogeneity allows supra-normal profits to exist. *Ex post* limits to competition make these profit durable over time. Imperfect mobility ensures that the firm can appropriate some of these durable profits. And *ex ante* limits to competition result in profits that are not subsumed by costs that are elevated due to competitor bids. These four assumptions about the nature of resources within the firm lead to recommendations for firms seeking competitive advantage: the firm should develop or acquire resources that are valuable, rare, inimitable, and embedded into the organization
(VRIO) in order to have a competitive advantage to generate sustainable superior performance (Barney, 1991).

This resource-based framework explains why some core competencies perform better than others. It also explains why some previously successful companies fail: their resources are imitated, or substitutes undermine their rarity. However, this framework also has flaws. Both path dependence and causal ambiguity are double-edged swords: they may deflect imitation of a resource, but they also complicate (or even invalidate) explicit strategies to develop such a resource. How is a firm to know if a fledgling resource will hatch into a VRI resource? Is the path to VRI ambiguous even to the firm managers? These concepts also suggest that the first mover will consistently have an advantage (Wernerfelt, 1984), a stipulation that has been questioned in theory and practice (Boulding & Christen, 2001; Lieberman & Montgomery, 1988).

More fundamentally, the RBV framework does not address how firms should evolve in rapidly changing environments; it is primarily static, not dynamic. How will a manager know when to abandon a VRIO resource? How will she know where to look and how to develop new VRI resources? These unstable environments erode the durability of supra-normal profits, and therefore of the underlying VRIO resources. Does this render the framework irrelevant in many contemporary sectors?

**Dynamic Capabilities View of the Firm**

At its broadest, the most important resource that a firm can possess is the capability is the underlying intangible skill of selecting appropriate resources to form a winning strategy (Barney, 2001). However, this definition makes the RBV tautological: a valuable resource is one that endures (Eisenhardt & Martin, 2000; Zollo & Winter, 2002).
In order to avoid this trap and to provide more specific, concrete advice to managers, the Dynamic Capabilities View (DCV) of the firm describes specific skills and processes within the firm that undergird the selection and development of these resources. A dynamic capability is defined as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments” (Teece et al., 1997, p. 516). Thus, dynamic capabilities are a subset of VRI resources that are comprised of processes that reconfigure its resources—including its existing operational processes—to match changing customer demands and competition. Building new processes requires learning, where experimentation dynamically generates gains in efficiency, as well as insight into new opportunities.

In rapidly changing environments, a firm’s durable competitive advantage does not derive from efficient operating routines (Porter, 1996), but instead from its repeated ability to adapt these operating routines to new environments, customer demands, and competitive threats. Structured, persistent, systematic processes within the organization that promote the evolution of operating routines are dynamic capabilities (Teece, 2012; Zollo & Winter, 2002). In the terminology of Mintzberg and Waters (1985), these routines are “deliberately emergent” in that the processes are pre-defined but the outcomes are unknown and unpredictable (Eisenhardt & Martin, 2000). Indeed, the intention of the process is to generate new conclusions to address prior uncertainties.

The above definition of a routine emphasizes its ostensive structure (Latour, 1986), where the process follows a recipe that is abstracted away from the actors or audience, much like a ‘standard operating procedure’. This structure provides efficiency for repeated processes by harnessing lessons from prior experience (March & Simon,
1958; Simon, 1969), as well as legitimacy to stakeholders in the outcome of the process (Feldman & March, 1981; Meyer & Rowan, 1977).

This ostensive perspective on a routine is in contrast (or complementarity) to the performative aspect of a routine, which introduces the duality of agency of the actors to the structure (Giddens, 1984). The process can vary from person to person, group to group, and iteration to iteration because it must be interpreted and implemented by varying human beings. The ostensive routine may describe the target activity (Nelson & Winter, 2009), but it is a guide, not a definitive prediction. “The ostensive aspect of the routine is the idea; the performative aspect, the enactment” (Feldman & Pentland, 2003, p. 102).

Dynamic capabilities are complex, path dependent, and specialized to both the product and other, complementary capabilities (“co-specialized”). As a result, these capabilities are typically inimitable (Helfat & Peteraf, 2003; Lippman & Rumelt, 1992). The DCV framework holds that these internal capabilities for renewal are responsible for a firm’s supra-normal performance over a long period of time even as the marketplace changes. Whereas RBV profits may emanate from a firm’s static Ricardian comparative advantage in competitive equilibrium, DCV profits are derived from efficient recognition and exploitation of new Schumpeterian opportunities that upset the market’s equilibrium (Shane, 2000).

**Hypothesis Generation and Testing**

Dynamic capabilities have been divided into three different categories: sensing, seizing and transforming (Teece, 2012). These three stages are part of a larger idealized sequence of subroutines that lead to commercialization. The founder has an initial
inspiration, which arises from observations of unmet demand from customers in a marketplace. This sensing also implies observations of existing or potential competitors to meet demand. This epiphany is codified, sometimes with the help of a framework. These initial assumptions about the nature of the eventual venture’s business model are stated as hypotheses. The founder then collects evidence to confirm or reject these hypotheses.

For entrepreneurs, sensing relates to “calibrating opportunities and diagnosing threats, [and] directing (and redirecting) resources” (p. 1398). In regard to a new venture concept, these processes are designed to collect and filter new information for the purpose of defining and refining the business model. Once the founder senses an opportunity, she acts to seize it by approaching customers with an offer. This seizing stage includes the solicitation of investment, assembly of an organization, and provision of marketing messages to potential customers. In entrepreneurship, the activities conducted during sensing may also apply to seizing: conversations with potential customers establish a relationship where the entrepreneur is designing a product specifically for those contacts. While this dissertation focuses on routines that are conducted by nascent entrepreneurs during the sensing phase, this latter set of routines may spill into the seizing phase. One such dynamic capability used by business people to sense and seize new opportunities is hypothesis testing (McGrath, 2010). “Hypothesis development, hypothesis ‘testing,’ and synthesis about the meaning of information obtained via search are critical function…” (Teece, 2007, p. 1323)

A hypothesis, in general, is a falsifiable statement (Popper, 1959) that can be examined with evidence to confirm or reject its veracity in the extant circumstance. The
use of evidence to confirm or reject hypotheses improves the performance of firms in general (Rousseau, 2006) and the likelihood of success for an entrepreneurial venture in specific (Blank, 2006, 2013). “Validated learning is the process of demonstrating empirically that a team has discovered valuable truths about a startup’s present and future prospects” (Ries, 2011, p. 39). The failure to test hypotheses is “the single greatest problem to beset new business organizations, namely the treatment of assumptions as though they are facts” (McGrath & MacMillan, 1995, p. 2).

The last stage in Teece’s categorization of dynamic capabilities is transformation, which applies primarily to the reconfiguration of resources within an established business in order to allow the venture to adapt to rapidly changing market conditions. Because this research focuses exclusively on nascent entrepreneurship, this transformation is not explicitly considered, though it is important element for venture growth and viability.

**Entrepreneurial Dynamic Capabilities**

Do emergent changes to the business concept increase the commercial potential of the venture? Evolutionary theory (Darwin, 1859) posits that under conditions of scarcity, some variations will be selected to improve the environmental fitness of the entity (Spencer, 1887). Alvarez, Barney, and Anderson (2013) and Alvarez and Barney (2013) applied evolutionary theory to entrepreneurial opportunity recognition founded on evolutionary realism (Campbell, 1960). While new ideas are often abundant, the resources required by an entrepreneur to develop and launch an idea into the marketplace remain scarce. Variation and selection produce fitter ideas when they are filtered through useful selection criteria (Amabile, 1988; Nelson & Winter, 2009; Simon, 1969).
Hypothesis testing offers this filter to select fitter ideas from among the variation of possible choices within a business model.

*Gaps in Literature on Entrepreneurial Dynamic Capabilities*

The DCV framework explains and predicts the achievement of supra-normal profits (or supra-normal survival) of existing firms in a changing market. It is rarely applied to startups that are seeking a promising business model, but have not yet entered the market.

For example, Felin et al. (2012) declared that dynamic capabilities are “explicitly collective rather than individual-level phenomena” (p. 9). This assertion excludes lone entrepreneurs from DCV altogether, even as they conduct solitary activities such as business model brainstorming or experiment design. The extant academic literature of dynamic capabilities has heretofore neglected routines of entrepreneurs acting alone or as assertive leaders of small groups. Similarly, Feldman and Pentland (2003) distinguished between ostensive and performative routines only in the context of organizations with the explicit assumption that multiple actors created interdependencies that shaped both the execution and mutation of routines. Lone nascent entrepreneurs may not encounter these types of interactions. Do these dual aspects of routines still play a role in nascent entrepreneurial activity?

It is important to note that the precondition for the role of dynamic capabilities in firm performance is a rapidly changing marketplace, which obviates existing knowledge about customer demand and competitive pressures. This precondition exists for most start-up ventures, even in industries that are not changing rapidly: the founders rarely have existing knowledge of the precise nature of customer demand, and so engage in
learning routines to generate and apply such knowledge in the reconfiguration of resources within their proposed business models.

Practitioner-oriented frameworks have filled some of the gap. The recently popularized Lean Startup Method (Ries, 2011) promotes three steps for testing hypotheses about a new venture. In the first step, the entrepreneur documents the core assumptions of the business model, typically using a normative definition embodies within the Business Model Canvas (Osterwalder & Pigneur, 2010). The Lean method treats these assumptions as hypotheses for falsification (Blank & Dorf, 2012). In the second step, the entrepreneur speaks to potential customers, seeking strong inferences (Platt, 1964) that the proposed solution addresses their problem in the customers’ own opinions (Blank, 2006). Hypotheses that are rejected by these customer conversations are reformulated (known as a “pivots”) and retested. The third step of the Lean Startup Method introduces prototypes as experiments—often called minimum viable products (Ries, 2011)—to validate market demand, prove technical capabilities, and prepare for low-cost alterations (Chandler, DeTienne, McKelvie, & Mumford, 2011; McGrath & MacMillan, 1995). This step builds upon the agile product development and lean manufacturing processes popularized by the Toyota production system where the “centrality of experimentation” (Ōno, 1988, p. 253) is especially vital in fast-moving industries as the basis for dominant paradigms shifts (McGrath, 2010). Experimentation may also lead to the creation of new ideas through recombination (Baker & Nelson, 2005; Lévi-Strauss, 1966). Customer interaction and experimentation are discussed in more detail below as activities to collect data for the purpose of hypothesis testing.
Proponents of the Lean approach contend that early and frequent feedback from potential customers generates rapid improvements in the business model, increasing the likelihood of venture success (Blank, 2013). Such feedback provides the evolutionary selection criteria that replaces the founders’ confirmation biases with direct evidence (Rousseau, 2006) of customer opinions to falsify alternative hypotheses (Mynatt, Doherty, & Tweney, 1977). However, to date, the Lean Startup Method has not been empirically tested for its efficacy in generating venture performance.

**Business Models**

A business model defines the logic by which the firm creates and captures value (Morris et al., 2005). There are several competing and overlapping frameworks within this field. First, the business model can be viewed as an activity system (Zott & Amit, 2010) that spans the boundaries of the firm, thus requiring that venture analysis consider the multiple levels of the firm, including its partners, value webs, and ecosystem. This concept may reconcile firm-specific attributes with a broader perspective on markets as interrelated systems (Lubik & Garnsey, 2015) especially in face of complexity, where direct causal relationships are difficult to discern, leaving only loose correlations or even a handful of steady states that are sensitive to initial conditions (Goldstein, Hazy, & Lichtenstein, 2010).

Second, the concept of a business model can be used as a unit of analysis to evaluate the paths and processes by which managers make decisions. This perspective makes the manager’s assumptions more transparent (Casadesus-Masanell & Ricart, 2010; McGrath, 2010). By analyzing decisions through the lens of the business model, the manager may be more able to move resources fluidly, increasing the dynamic capacity
for strategic agility (Doz & Kosonen, 2010). By using the business model as a tool to compare historical decisions to impending decisions, the manager may also compare the lessons that emerged in the past to the heuristics for the future in order to determine which parts of future decisions are derived from historical wisdom or an unexamined mental model (Gavetti & Levinthal, 2000).

A third perspective on business models asserts a normative definition (Kalinowski & Vives, 2013), advocating for a list of specific components that comprise a “complete” model. A description of the constituent parts of the business model creates a shared ontology that allows managers to communicate the core aspects of their venture to other founders, partners, and investors as a tool to encourage commitment (Shane & Delmar, 2004) and focus managerial competencies (Tripsas & Gavetti, 2000).

These three perspectives on the concept of a business model converge within the realm of dynamic capabilities. In rapidly changing environment, a firm can achieve superior performance by reconfiguring its activity systems, including its relationships with other firms. This transformation requires explicit understanding of prior actions, models, and assumptions. The emergent business model prescribes the decisions and actions of the firm in detail. Moreover, the business model can be the focal point in each of the three major categories of dynamic capabilities: sensing, seizing, and transforming (Teece, 2012).

Business Model Canvas

One popular normative framework of a business is the Business Model Canvas (Osterwalder & Pigneur, 2010), which includes nine purportedly exhaustive and non-
overlapping elements to describe the logic by which the firm creates and captures value.

The canvas contains nine elements:

*Customer segments* (CS) are comprised of groups of paying customers with common needs and attributes. There are several different types of approaches to customer segmentation: niche, segmented along a continuum, diversified, and multi-sided. A single product or service can have multiple target segments, but they are usually prioritized. If deliberately selected and pursued by the entrepreneur, this segmentation and prioritization form the basis of the firm’s corporate strategy (Porter, 1980) and marketing approach. (Alternatively, according to Porter, a firm might aim to become the low cost provider. This strategy would be capture in the *cost structure* element described below.)

The *value proposition* (VP) is more than just a description of the product or service, but also an articulation of the benefits of the service as it addresses the needs of the various customer segments. Typical propositions include quality, performance, design, or impact on status. Both the *value proposition* and the *cost structure* capture details about the technologies employed in the product or service.

*Channels* (CH) refer to the method by which the venture interacts with the customer to deliver the product or service. These may be the firm’s own communications, sales, or distribution channels, or those of a partner. Through these channels, the firm establishes a *customer relationship* (CR), defined by the context that the firm aspires to build around the specific business transactions, ranging from personal one-to-one contact through co-creation with customer communities to automated self-service.

*Revenue streams* (R$) are the one-time or recurring transaction of cash from the customer to the firm based on an asset sale, usage fee, subscription, lease, license,
commission, or advertising. This element includes the pricing mechanism, which can range from fixed prices, sometimes specific to product feature or customer segment, to dynamic prices through negotiation, market conditions, or auctions in order to maximize profitability or yield.

The *key resources* (KR) within the firm refer to the physical, intellectual, human, and financial capital that support the firm’s *key activities* to produce the good or service, solve problems, or construct the platforms that underlie the firm’s value proposition. These *key resources* include leadership and organizational structure. In a study of 24 different firms, Stuart and Abetti (1987) concluded that the leadership traits of the entrepreneur was positively correlated with performance. In a study of 1,053 firms, Cooper, Gimeno-Gascon, and Woo (1994) found that various types of human capital contributed differentially to start-up performance, but that injection of financial capital consistently improved venture performance. These *key resources* might also factor into the entrepreneur’s venture strategy, as the basis for core competence or other resource-based views of the firm, as discussed in more detail below.

The element of *key activities* (KA) is comprised not just of the functions and processes within the firm, but also the externally imposed constraints and incentives from government regulation.

Due to advances in communications technology, firms are increasingly establishing *key partnerships* (KP), including alliances, joint ventures, and integrated buyer-vendor relationships, in order to optimize production, achieve economies of scale and scope, reduce risk, and extend their own capabilities beyond their internal resources. This element of the canvas also captures external forces within the firm’s environment.
that define the dynamism of the venture’s market, including the actual and potential impacts of suppliers, customers, new entrants, and intra-industry rivalries.

These resources, activities, and partnerships dictate a *cost structure* (CS) for the firm.

The Canvas claims to offer a heuristic model that highlights the vital elements of a complete, comprehensive, and aligned business model, such that elucidating the model, especially during the conceptualization of a business concept by nascent entrepreneurs, will improve the chance of eventual commercial success (Osterwalder & Pigneur, 2010).

*Embeddedness*

Many theories of business models are abstracted away from the particular environments in which a new venture operates. These abstractions allow extrapolation and extension. However, they also neglect some of the benefits of embedding the venture’s environment into its business model. London and Hart (2010) defined the embeddedness of a business model as its “capability to gain a deep sense of the social context and a detailed knowledge of the intrinsic economic rationale of the local economy” (location 1108). The influence of the economic, institutional, and communal structures on the entrepreneur’s business model has also been noted by Seelos, Mair, Battilana, and Dacin (2011) and Jack and Anderson (2002).

These activities rely upon the mental models of both entrepreneurs and consumers. A mental model encapsulates “people's views of the world, of themselves, of their own capabilities, and of the tasks that they are asked to perform, or topics they are asked to learn” (Gentner & Stevens, 1983, p. 7) that embody the assumptions, preconceptions, and vocabulary that inform their perceptions about the world around
them to “invoke the public familiarity with the technical artifacts and social structures of the existing [systems of products or services]… to locate their ideas within the [existing] set of understandings and patterns of actions” (Hargadon & Douglas, 2001, p. 477).

**Gaps in Literature on Business Models**

Two substantial gaps exist in the literature on business models. First, although the Business Model Canvas was constructed from prior literature (Osterwalder, 2004) and authored by more than 400 collaborating authors (Osterwalder & Pigneur, 2010), the Canvas has not been tested empirically in peer-reviewed journals. There is as yet little evidence that this particular configuration of ingredients within a business model are indeed exhaustive and non-overlapping, nor is there evidence that the framework is explanatory or predictive of the performance of the venture that employs the framework.

The second gap relates to all of the theories of business models: they do not address the sequence of priority for nascent entrepreneurs. Are some portions of a business model more relevant for entrepreneurs who have just commenced the process of conceptualization? Are some portions of a business model more fruitful fodder for mature businesses? Is there a pattern of using the elements of a business model that explains or predicts the success of nascent ventures? The theories of business models, including the Business Model Canvas, do not offer any propositions on these patterns.

**Activities**

Recent attention has focused on the specific activities that managers conduct to collect evidence for hypothesis testing. These activities highlight how managers practice this dynamic capability by examining the atomistic components, as well as the interactions between these components (Felin et al., 2012).
Before we can discuss specific practices, we must tackle the goal that these practices intend to achieve. We begin with the first step in the creation of a new product: opportunity recognition. At the extremes, opportunities either exist a priori and are thus discovered by a searching and willing entrepreneur (Shane, 2012) or they do not exist a priori and are created by the entrepreneur (Venkataraman, Sarasvathy, Dew, & Forster, 2012). This debate operates largely on two dimensions for how entrepreneurial opportunity can be defined: epistemological and ontological. Both levels are heavily influenced by the pragmatism of John Dewey.

Does an opportunity exist even if no one has yet conceived of it? This proposition implies that knowledge (i.e. an entrepreneurial opportunity) is distinct and separate from what is knowable (e.g. customer desires). Dewey (1896) asserted that this distinction is false. His theory of instrumentalism declares that an actor interacts with and impacts her environment such that knowledge and the knowable world become inextricably linked. He illustrated his theory with Darwin’s observations about natural ecosystems, where each entity is both a creator and recipient of knowledge and action such that the knowledge and the knowable are indistinguishable. This duality is also reinforced in structuration theory (Giddens, 1984), where agency (i.e. the freedom of the entrepreneur to act) and structure (e.g. the marketplace) recursively impact each other and blur the line between them.

The precursor to action is the existence of a “problematic situation” (Dewey, 1903). A human participant interacts with this situation by forming hypotheses about the nature of the problem. The solutions to this problem are found through experiential experimentation followed by reflection and, if merited, the actor’s adaption to this new
knowledge. The “truth” of an idea is defined by its pragmatic utility in addressing a human goal related to the problematic situation. A “warranted assertion” (Dewey, 1941) conveys an idea that emanates from successful reflective experimentation and is oriented towards solving a problem. Because problems are situational, the truth of an idea depends on specific circumstances; an idea cannot be universally or ontologically true in all conditions. If an idea fails to address a goal in a given circumstance, then it is untrue in that circumstance. This reliance on context lies at the heart of naïve realism (Dewey, 1958).

From the epistemological perspective of instrumentalism, it is not useful to discuss an entrepreneurial opportunity divorced from the perceptions of the entrepreneur and the target customer (Alvarez et al., 2013). The entrepreneur creates the idea of a new product or service for both herself and her customers. Entrepreneurs find true opportunities through a process of reflective experimentation to arrive at solutions that address specific experienced or imagined customer problems. This not only requires interaction with customers but also a more flexible expectation concerning the business logic of the company. The entrepreneur can only effectuate a vision related to this logic to the extent that the customers are willing to understand his or her vision (Sarasvathy, Dew, Velamuri, & Venkataraman, 2010). Such emphasis on defining products based on their utility to customers is also evident in ideas of Schumpeterian innovation (Schumpeter, 1934) and definitions of creativity that emphasize utility (Amabile, 1988).

Extant literature suggests two loosely structured, repeatable processes to assist the entrepreneur in sensing, learning, filtering and applying new information. First, customer interaction (also called customer discovery) (Blank, 2006) is a process to conduct open-
ended interviews with potential customers (Blank & Dorf, 2012; Maurya, 2012) in order to confirm, reject, and alter hypotheses within the business model. These interviews combine the demonstrated importance of incorporating customer reaction into product design (Kotler, 2011) with the data-driven decision-making of evidence-based management (Rousseau, 2006).

Second, the creation and execution of experiments—often called minimum viable products (Ries, 2011)—validate market demand, prove technical capabilities, and prepare for low-cost alterations (Chandler et al., 2011). Experimentation has also been positively related to entrepreneurial performance in several studies around the theory of effectuation (Sarasvathy, 2008). Entrepreneurs who practice these entrepreneurial dynamic capabilities of customer interaction and experimentation empirically improve their ventures’ performance. The primary utility of experimentation is the direct comparison of pre-determined ideas with external data to help the entrepreneur select the more promising option.

Experimentation may involve local or distant search (Fleming, 2001). The former focuses on ideas that are already familiar to the entrepreneur and may result in the discovery of nearby local optima. The latter relies on ideas that are unfamiliar to the entrepreneur to find a global optimum. Because confirmation bias promotes the familiar over the unfamiliar, the entrepreneur’s own cognition may restrict the potential of global search. This concept will be discussed in more detail below.

*Gaps in Literature on Activities*

The theories listed above declare that customer interaction and experimentation aid in opportunity recognition. Three questions remain. First, what is the empirical
evidence that testifies to the importance of these two activities in identifying lucrative opportunities and the configuration of resources that would eventually generate venture success? Second, the literature treats these two activities as vital complements. Are these two activities independently associated with venture performance, or are they dependent on each other? The third question focuses on the intersection of opportunity recognition and dynamic capabilities. Are these activities repeatable routines that consistently contribute to venture performance, where more experimentation is better? Is there a window of increasing returns with a boundary beyond which additional attention on opportunity recognition would undermine eventual venture performance?

**Cognition**

The study of entrepreneurship has considered errors in cognition since the field was founded. Schumpeter (1934) wrote, “It is not objectively more difficult to do something new than what is familiar and tested by experience, but the individual feels reluctance to [pursuing something new] and would [feel reluctance] even if the objective difficulties did not exist” (p. 86). (While Schumpeter was referring to customer cognition at the time, this same phenomenon applies to the entrepreneur as well.) More specifically, the entrepreneur’s cognition plays a role within the process of refining and validating a new venture concept.

Dynamic capabilities emphasize the collection and interpretation of knowledge and may be informed by theories of the knowledge-based view of the firm. These perspectives coalesce around the belief that the firm is not a single, monolithic decision-maker. It is comprised of individuals who, together, make decisions (Cyert & March, 1963). These individuals have limits to their mental capacity (Simon, 1972) and their
ability to absorb new information (Cohen & Levinthal, 1990). The firm exists to aggregate the knowledge of its employees (Grant, 1996), especially tacit and idiosyncratic knowledge, which are specialized to the firm’s products. The managers of the firm interpret this knowledge to create products in a more efficient or innovative way than its competitors (Spender, 1996). This knowledge becomes embedded in the organization in the form of routines, which are “patterns of interactions that represent successful solutions or particular problems” (Teece et al., 1997, p. 520). These include procedures, rules, and norms (March, 1991) to coordinate complex behaviors (Zollo & Winter, 2002).

Several different strands of management literature explore the “microfoundations” of a process. This term is loosely defined in the dynamic capabilities literature (Eisenhardt et al., 2010; Teece, 2007) as sub-routines or sub-components upon which dynamic capabilities are built. These include the characteristics that exist outside of and independent from the capability itself, or even the operating activities of the firm.

The application of knowledge through dynamic capabilities in changing marketplaces relies on heuristics, including abstraction from prior experience and reliance on a diversity of mental models across members of a team, to capture instinctive reflections when there is insufficient time and information for analytical reflection (Eisenhardt et al., 2010; Tversky & Kahneman, 1974). Heuristics rely on individual cognition, which introduces the potential for cognitive biases (addressed below). Cognition within entrepreneurship is described as “the knowledge structures that people use to make assessments, judgments, or decision involving opportunity evaluation, venture creation, and growth” (Mitchell et al., 2002, p. 97; Mitchell et al., 2007).
Zollo and Winter (2002) contended that the development of dynamic capabilities occurs in three learning stages, each with different levels of required cognitive investment. Experience accumulation is semi-automatic, and thus does not require much cognitive effort. Articulating the knowledge gained from experience requires communication, which imposes a higher cost. Codifying the articulated knowledge requires the highest level of investment. In terms of the evolutionary nature of knowledge, accumulation is required for a manager to search for variation, whereas articulation and codification are necessary for managers to select a subset of ideas from among these variants for inclusion in the business. Cognitive intensity peaks during routines that focus on selection. As we discussed above, this stage is the most vital to the reconfiguration of resources.

This reliance on cognitive effort is inevitably accompanied by flaws in cognition by the individual and the group. Several theories suggest that the manager’s cognitive process is rarely ideal. She does not hold all pertinent information during the decision-making process (Hayek, 1945). Even with limited knowledge, her decision-making is bounded by prior experience and cognitive limitations (Simon, 1972). Primary among these limitations is cognitive bias (Nickerson, 1998), whereby a manager becomes attached to information that supports the potential market success of her venture and rejects any information that refutes its potential (Dane, 2010; Klayman & Ha, 1987). The articulation and codification of knowledge in the pursuit of sensing and seizing new opportunities are prone to deleterious bias. Successful dynamic capabilities systematically erode this bias (Teece, 2007).
This bias is especially pronounced in entrepreneurs. The creation of a new venture is challenging. Not only do many ventures fail, but these failures are publically evident, from shuttered local restaurants to defunct software companies. Aspiring entrepreneurs considering starting their own venture must therefore believe that their ideas and skills are sufficient to avoid the causes of failure. This supposition is supported by empirical evidence: entrepreneurs are more optimistic than other types of business professionals (Hmieleski & Baron, 2009; Lowe & Ziedonis, 2006). This optimism leads them to adopt heuristics that promote confirmation bias more than other business professionals (Busenitz & Barney, 1997).

Hmieleski and Baron (2009) explored the implications of dispositional optimism, defined as “generalized expectancies for experiencing positive outcomes” (p. 475). They assert that this predisposition may provoke goal conflict, where the entrepreneur cannot discern that some ideas are better than others. The entrepreneur may thus attempt to pursue several ideas simultaneously, becoming overextended. This line of research acknowledges that individuals with different characteristics or predilection may have different types and levels of bias.

Bias exists on many different levels. First, bias is evident in the minds of individuals (Klayman, 1995; Tversky & Kahneman, 1974). It is also evident in groups (Janis, 1972), where a dominant paradigm can overwhelm the ability for all of the members of a team to objectively review new evidence to alter assumptions. Second, bias exists on different levels of cognition. It may be apparent to the individual on an intellectual, conscious level such that the individual can recognize the irrationality of blind allegiance to an idea (e.g. favoritism towards a professional sports team) or it may
be a sub-conscious attraction where recognition of bias is unlikely (e.g. fondness for certain colors). Theories that anticipate bias must therefore allow or encourage multi-level analysis, from individuals to groups and from conscious to subconscious cognition.

There are many potential sources of bias. They can be derived from past experience, education, context, culture, or incentive structures (Tversky & Kahneman, 1974). Some types of people may have a predilection for bias based on their genetic composition. Bias may also emanate from previously successful strategies that prompt narrow, local searches for new ideas instead of wide, distant searches (Teece, 2007). These errors can be compounded in rapidly changing environments with path dependencies.

Dynamic capabilities can defeat confirmation biases. “The proficiency with which such biases are overcome and a new opportunity is embraced is likely to depend importantly on the quality of the enterprise’s routines [and] decision rules… Accordingly, competitive advantage can be gained by early adopters of techniques to overcome decision biases and errors” (Teece, 2007, p. 1328).

**Personality Type**

Variation between individuals executing those routines might be caused by differences in personality type. To illuminate the connection between learning routines and the traits of learner, several studies have established and applied the Big Five—openness, conscientiousness, extroversion, agreeableness, and neuroticism (OCEAN)—as exhaustive non-overlapping psychometric traits that provide reliable metrics for management research, including entrepreneurship analyses (Costa & McCrae, 1992; Digman, 1990; Goldberg, 1999; McCrae, 1987; Zhao & Seibert, 2006).
A person who demonstrates a high level of openness to experience (also often labeled as intellect) is curious and creative, demonstrating divergent thinking, whereas a person with a low score in this personality dimension can be seen as conventional with narrow interests. Conscientiousness is defined as a person’s degree of organization and persistence to accomplish goals. Low scores in this dimension reflect low motivation and undependability. People high in extroversion are energetic and enthusiastic, seeking stimulation from large groups of people, in contrast to introverts, who are quiet and independent. People who score high in agreeableness are trusting and cooperative, as compared to someone who is ruthlessly self-interested. Neuroticism is roughly the inverse of emotional stability. (This scale is sometimes reversed, and labeled “resilience”.) Those who score high in neuroticism are anxious, self-consciousness, and impulsive. Those who score low in neuroticism are calm and self-confident.

Using this scale, Zhao and Seibert (2006) found that, as compared to managers, entrepreneurs score higher on openness and conscientiousness and lower on agreeableness and neuroticism with no significant difference in extroversion. Ciavarella, Buchholtz, Riordan, Gatewood, and Stokes (2004) assessed the influence of the Big Five on long-term venture survival and found mixed agreement with Zhao and Seibert (2006): extroversion is positively related to venture success, but openness is negatively related to venture success. The other three traits showed no significant relationships.

Felin et al. (2012) attested that “the study of Big 5 personality characteristics has a long history in organizational behavior; opportunities exist for bridging this work with work on aggregate, interactional and emergent organizational behavior. Routines and
capabilities, in other words, might be crucially dependent on the characteristics of individuals involved” (p. 22).

**Improvisation**

Several authors have emphasized the importance of improvisation, which is defined as the act of extemporaneously formulating and executing novel ideas, relying on the resource at hand (Hmieleski, Corbett, & Baron, 2013; Moorman & Miner, 1998). Improvisation is not the complete absence of structure. Instead, it is action born from automatic reaction, which can be instinctual or trained. In either case, heuristics guide the improvisational action (Davis, Eisenhardt, & Bingham, 2009).

Improvisation is defined as the act of extemporaneously formulating and executing novel ideas, relying on the resource at hand (Hmieleski et al., 2013; Moorman & Miner, 1998). It is the convergence of design and execution (Baker, Miner, & Eesley, 2003). The choices that the entrepreneur makes in fast-paced environments rely on learned heuristics, including abstraction from prior experience to capture instinctive reflections when there is insufficient time and information for analytical reflection (Davis et al., 2009; Eisenhardt et al., 2010; Tversky & Kahneman, 1974). The capacity to act immediately upon instinct is improvisation. Hmieleski and Corbett (2006) established improvisation as a significant partial mediator between personality traits (using the Big Five) and entrepreneurial intent (Bird, 1988).

In discussing dynamic capabilities above, we highlighted the duality of routines: they are comprised of ostensive structured recipes and performative instances of the recipe as interpreted and implemented by each actor. This latter aspect encompasses the
agentic practice of a routine, which is inherently improvisational (Bourdieu, 1990; Feldman & Pentland, 2003).

_Gaps in Literature on Cognition_

First, although personality traits have been studied exhaustively in association with entrepreneurial intent and venture success, they have not been associated with the activities that occur during repeatable routines that occur during opportunity recognition. Felin et al. (2012) recommended that future research explore the relationships between the Big Five and dynamic capabilities in order to build bridges between these two research streams to further inform the practice and teaching of entrepreneurship.

Second, dynamic capabilities are treated as repeatable processes that generate new information. However, one must assume that the new information not only changes the configuration of the firm’s business model but also the expression of the dynamic capability itself (Feldman & Pentland, 2003). Repeating the same activity to generate the same new information does not improve the efficacy of the reconfiguration. The implementation of a learning routine impacts the entrepreneur’s mental model (Maritan & Peteraf, 2010), which may alter subsequent implementations. Some entrepreneurs have greater facility for incorporating new information to quickly change the details of a learning routine.

Within customer interaction, this may manifest as an evolution to the interview script such that the entrepreneur can alter questions from one interview to the next and even in the course of a single interview, improving its flow and utility. Improvisation reflects this capacity to reflect and act extemporaneously. Yet, improvisation during iterative experimentation would undermine the ability to compare successive results and
to isolate important variables, and so reduce the benefit of the activity. In this way, improvisation might amplify the impact of one type of activity but attenuate the impact for another type. Is the predilection for improvisation a boundary line for the utility of different activities for collecting evidence during hypothesis testing?

The next section of this dissertation explains how we address these gaps in the literature through four phases of research studies.
CHAPTER 4: RESEARCH DESIGN

Our research explores the efficacy of the entrepreneurial dynamic capability of hypothesis testing by nascent entrepreneurs during venture conceptualization. It is comprised of four distinct phases to address the four research questions described in Chapter 2. In this section of the dissertation, we describe in detail the design of these phases (Figure 2, based on Teddlie and Tashakkori (2009)).

Figure 2: Research Design across Four Phases

Rationale for Mixed Methods

While recipes for creating new concepts may seem simple, the thoughts, actions and outcomes of the entrepreneurs are complex. Valid, reliable findings on the efficacy of such methods require triangulation from multiple methods and theories (Teddlie & Tashakkori, 2009).
In the first phase of research, we seek empirical evidence of the impact of hypothesis testing on venture performance, as well as the efficacy of the categorization of validated hypotheses within different components of a business model, labeled “1. QUANT” in Figure 2 addressing Research Question One. We use activity logs from a web tool used by nascent entrepreneurs to avoid issues of recollection and sample bias. This is accomplished by constructing propositions\(^1\) from the literature around the relationship between independent and dependent variables. The ideal research design to test these propositions is a quantitative analysis (Creswell, 2008). Commencing with this stage allows us to establish the core relationship. Subsequent phases determine the boundaries and microfoundations of this core relationship.

In a second phase of research, we explore the contributions of specific activities conducted during the conceptualization process to venture success per Research Question Two (“2. quant” in Figure 2). We base this study on survey data for two reasons. First, to our knowledge, no other data have been collected on the activities in question, especially from participants in a quasi-controlled environment with a standardized dependent variable. Second, we desire to collect other information about the respondents to cross-reference matched responses for the third phase of our research.

In the third phase, we seek to investigate the effects of the personality traits and practices that precede these activities to identify the existence of significant cognitive antecedents as discussed in Research Question Three and labeled “3. quant” in Figure 2.

\(^1\) Because this dissertation analyzes the routines around hypothesis testing by entrepreneurs, the falsifiable statements that we make within this dissertation are labeled as propositions, not hypotheses, to reduce confusion between what we are studying (hypothesis testing) and how we are studying it (constructing and testing propositions). Typically, academic articles only label something as a proposition when it is not immediately tested with evidence. We are not conforming to that traditional usage.)
The third phase is designed to complement and refine the findings from phase two (Creswell & Clark, 2011; Morse, 2010). This phase relies again on quantitative analysis (“3. quant” in Figure 2) from a subset of the sample from the second phase.

The fourth phase of this research addresses the question of how practicing entrepreneurs conceive of their own business models as identified in Research Question Four. We seek to apply a method that would help extract themes from the lived experiences of the entrepreneurs to “[explore] and [understand] the meaning individuals or groups ascribe to a social or human problem” (Creswell, 2008, p. Loc 391). This effort requires qualitative (“4. qual” in Figure 2) interviews to construct grounded theory (Charmaz, 2006; Glaser & Strauss, 1967). We ask open-ended questions in semi-structured interviews. The content within these interviews is coded in order to solicit themes and articulate contextual theories (Saldaña, 2012). We compare this inductive framework to extant literature about business models. In the fifth phase of this research design, this dissertation integrates the findings of these four research phases to coalesce evidence of the dynamic capability of hypothesis testing among nascent entrepreneurs.

Unit of Analysis

As part of our effort to triangulate findings into a single focal point, the four phases of this research intentionally examine two different units of analysis. In the first and second phases, we look at the activities conducted by the entire entrepreneurial team because we are focused on their aggregate efforts to generate venture success. In the third phase, we look at the traits of the individual who is leading the team. This person conceived of the initial idea, recruited team members, manages the workflow and team dynamics, and makes final decisions around the venture’s evolution. The influence of the
founder within the upper echelon of management has been demonstrated to have a significant impact on firm performance, especially relevant for venture teams with only a few members (Hambrick, 2007; Hambrick & Mason, 1984). In the fourth phase, we again focus on the leader of the teams, but ask about their historical experiences, not their inherent traits.

Points of Integration

There are several points of integration between these four studies. The first phase of the research directly informs the research questions for Phase Two and Phase Four (solid line in Figure 2). Specifically, the finding in Phase One that hypothesis-testing impacts venture success leads us to study the activities for evidence collection within hypothesis testing. The finding in Phase One that the Business Model Canvas does not explain the distribution of validated hypotheses leads us to question in Phase Four how practicing entrepreneurs define a business model. The findings from Phase Two that highlight the relationships between the activities used during evidence collection and venture success lead us to inquire about the microfoundational antecedents of these traits in Phase Three (solid line in Figure 2). Finally, the findings from all four of these phases are integrated into this dissertation (dashed lines in Figure 2) to derive a conclusion about the impact of hypothesis testing.

Sample

The first, second, and third phases of this research use data on the participants, practices, activities, and outcomes of teams in an American cleantech accelerator program. An accelerator program hosts and guides entrepreneurs as they conceptualize their new venture ideas. The accelerator program we examine in this research was
founded in 2005 to promote entrepreneurial startups that commercialize technologies to
generate clean energy and clean water ("cleantech"), often for consumers at the base of
the world’s economic pyramid. The cleantech accelerator program has grown steadily
each year, now boasting over 3,500 alumni around the world who have cumulatively
raised over $1 billion in investment through 2014 to support the launch and growth of
their ventures. At the conclusion of each year’s program, teams compete by pitching their
venture concepts to a panel of judges. The top three teams within several categories of
each regional competition progress to an annual global competition, where the top three
ventures in each category receive substantial prizes to launch their ventures. As the
program gained in popularity, the program increased to eight regions within the U.S.
Starting in 2013, the accelerator program encouraged non-Americans to apply and
compete within separate overseas regions, but these numbers remained low at the time of
our data collection.

This sample of cleantech entrepreneurs is appropriate for examining the impact of
entrepreneurial dynamic capabilities for several reasons. First, the studied market is
growing rapidly, with US$6.4 trillion estimated to be invested in the sector over the next
decade, of which US$1.6 trillion is expected to be directed toward small businesses
operating in developing countries (WorldBank, 2014). Yet, one study reports that 63% of
information ventures fail within four years, often due to poor planning (ISBDC, 2015).
Verifying and refining drivers of success for these small businesses may have a
substantial economic impact to investors, customers, regional economies, and the
entrepreneurs themselves.
Second, cleantech entrepreneurs address major social and environmental problems—typically for the 4 billion people at the base of the world’s economic pyramid (BoP) who earn less than US$2 per day and where 1.6 billion lack access to electricity (London & Hart, 2010). Electric energy—and the lights and appliances that it enables—is a vital missing ingredient to economic development and poverty alleviation (Galvin & Yeager, 2009). Many cleantech ventures apply novel technologies and business models to generate low-carbon electricity or uncontaminated water for perpetually impoverished communities. Discovering repeatable learning routines that would improve the success of cleantech ventures would have a global impact on poverty alleviation and carbon mitigation. But this group may also exhibit some strong personality traits that might be easier to analyze than in other populations of entrepreneurs. Cleantech entrepreneurs may explicitly opt for slower growth or lower profits in order to serve these segments. The optimism required for pursuit of such social enterprises may increase the founders’ biases; their altruistic attachment to improving the greater good may blind them to information that suggests that their specific approach is not viable. If hypothesis testing can overcome elevated bias within this environment, such methods might offer even greater gains to ventures in sectors with less propensity for founder’s bias.

Third, cleantech entrepreneurs occupy a narrow niche, and thus are subject to similar external trends. The teams in the cleantech accelerator program are judged by identical performance measures, where a panel of experts adjudicates the pitch competitions using standardized rubrics.

Fourth, the participants in the cleantech accelerator program are all at a similar stage of development. They have already developed an initial concept, which is
elucidated and evaluated as part of the application process. Furthermore, as required in the application process, they have not generated substantial revenue from these concepts. As a result, they are all nascent startups. None is a division of an existing corporation.

Fifth, the entrepreneurs within these teams have similar ambitions. Because the three-month program is time consuming, these entrepreneurs are not pursuing this idea on a whim. Nor are they students engaged in an academic exercise. Instead, they typically desire to refine the idea, win the competition, and use the prize money and notoriety to launch their ventures. Given all these similarities, we can better isolate the specific impacts of entrepreneur’s activities on venture performance.

Validity

This stream of research contains several sources of validity and reliability. A few arise directly through the integration of the four phases. As mentioned above, sequential triangulation using multiple methods and units of analysis increases our confidence that the final conclusions are indeed justified and significant in broader entrepreneurial practice. This triangulation adheres to the principles of mixed method research (Morse, 2010) in that all four phases are motivated by the same theoretical drive to determine the existence and boundaries of an entrepreneurial dynamic capability of hypothesis-testing. This broad question was first identified in the first phase of the research. Each subsequent phase tested clarifying propositions and conditions.

Second, because all four studies focus on datasets from nascent cleantech entrepreneurs, we control for many extraneous external influences that might impact a comparison of entrepreneurs across disparate industries. This improves our internal validity such that we are able to explore a sample of entrepreneurial experiences within a
singular industry, eliminating many of the exogenous factors that would impact an
analysis of samples that cross industries and stages of venture development.

Finally, any single study may have been subjected to researcher bias, because
each depended substantially on researcher’s interpretations of participant responses. Two
of the quantitative studies reduced some of this researcher bias by asking entrepreneurs to
self-report their own activities in narrow, quantified measures using scales. However,
these survey data asked for reports of activities in hindsight, subject to memory bias. One
of the quantitative studies employed data from web logs, which reduces memory bias but
introduces a different kind of method bias. The qualitative study exacerbates researcher
bias, but reports deeper, richer information that allows the reader a more transparent
perspective. By employing different methods, the combination of these four studies
increases their combined reliability (Creswell & Clark, 2011).
CHAPTER 5: FINDINGS

In this section, we summarize the findings from the four research papers, which can be found in their entirety in the appendices of this dissertation.

Our first research question revolves around the importance of hypothesis validation, as well as the explanatory power of categorizing these hypotheses within the Business Model Canvas. In the first phase of the research, we collected web logs from 185 teams on the number of hypotheses that they validated during the cleantech accelerator program. These raw counts were labeled by the entrepreneurs based on the specific aspect of the business model that they were attempting to explore as represented in the Business Model Canvas.

Using binary logistic regression, we found that teams who conducted any hypothesis validation whatsoever performed more than twice as well in the competition as teams who performed no validation, implying that hypothesis testing is indeed a valuable dynamic capability. However, there was no relation to the number of validated hypotheses and the team’s performance: more is not better. Moreover, no component of the business model was significant as a category for validated hypotheses. However, a k-means cluster analysis revealed that teams that validated more hypotheses within the categories to the targeted customer segments, value propositions and channels performed better than teams that validated few hypotheses in each of these three components of their business model. This implies that portions of the business model may be more important areas of focus for hypothesis testing than others for nascent entrepreneurs.

Our second research question focuses on a few of the activities that entrepreneurs conduct to collect evidence as part of their hypothesis testing: customer interaction and
experimentation. In the second phase, we conducted an empirical cross-sectional analysis using surveys collected from 248 teams from the same cleantech accelerator program to determine the correlations of these activities to venture success. This dataset was analyzed using binary logistic regression.

We found that teams that engaged in customer interaction but not experimentation to construct and validate their business concepts increased their chance of winning an award by 50% compared to those who did not conduct any customer conversations. On the other hand, teams that conducted experiments without customer interaction did not improve their performance. Finally, teams that engaged in both activities performed worse than if they only focused on customer interaction, but better than if they did not engage in any customer interaction at all. These initial findings suggest that these two activities are not complementary in our sample as expected by the literature. They are substitutive. In fact, the use of both activities reduces the likelihood of success (Figure 3).

**Figure 3: Interactions of Activities for Venture Success**
Our third research question seeks to understand the microfoundational antecedents of the activities discovered in the second phase above. In the third phase, we explored the personality traits and practices that precede and predict the activities of customer interaction and experimentation in order to determine the role of cognition in hypothesis testing. Using data from the same survey to cleantech entrepreneurs from Phase Two, we examined the impact of the Big Five personality attributes—openness, conscientiousness, extroversion, agreeableness, and neuroticism (OCEAN)—and the entrepreneurs’ predilection for improvisation on venture performance. The data were analyzed with structural equation modeling.

When looking for microfoundational antecedents of these activities, only the trait of conscientiousness within the leader of an entrepreneurial team predicted its use of experiments. None of the other Big Five traits or a predilection for improvisation was a significant antecedent. This research also made a contribution to the literature by beginning the search for valid theory and reliable scales for exploring the quantitative nuances of the entrepreneurs’ interviews with potential customers.

Our fourth research question builds on the findings from the first phase of this research to determine how practicing entrepreneurs envision their own business models. In the fourth and final phase of this research, we interviewed 30 cleantech entrepreneurs selling renewable distributed electricity to impoverished people at the bottom of the world’s economic pyramid in undeveloped countries.

We found that the extant definition of a business model neglects several positive attributes of the venture’s environment. Following protocols for grounded theory, we developed an alternative framework that embeds the venture’s business model into the
habits, mental models, and existing product constellation of its anticipated customers (Figure 4).

**Figure 4: Business Models for Cleantech Ventures at the Base of the Pyramid**

The following chapter describes the possible explanations and implications of these findings on entrepreneurial dynamic capabilities.
CHAPTER 6: DISCUSSION

Our finding that hypothesis testing improves venture performance provides empirical support for general theories of scientific discovery (Popper, 1959), theories of dynamic capabilities (Teece, 2007) and theories of entrepreneurial practice (Blank, 2006; Ries, 2011), suggesting the existence of an entrepreneurial dynamic capability that improves the likelihood of venture survival.

Hypothesis Testing

The lack of significant correlation between the number of validated hypotheses and venture success—more is not necessarily better—may be explained by differences in the scope of the hypotheses being tested. Founders with broad sweeping hypotheses may omit granular nuance or combine multiple assertions into a single test. Others may divide complicated assertions into many small components. Our research method and dataset did not allow for the consideration of the scope of the hypotheses.

Similarly, our method and data did not assess the validity of the team’s interpretations of evidence or its stopping rules to determine when a hypothesis generates sufficient support to be declared valid. It is possible that teams set different thresholds.

Alternatively, despite their general similarities within the cleantech sector, the startup ventures within this research may have been exploring opportunities in different subsectors or different geographies, which may be subjected to different levels of change within their marketplaces. Eisenhardt and Martin (2000) posited that dynamic capabilities exhibit drastically different characteristics in environments when change is only moderate as compared to environments where change is extreme. They defined moderately changing markets as those where change is linear and predictable, with insignificant
impact on market structure or firm boundaries. As a result, existing knowledge is adequate for survival. In these types of markets, dynamic capabilities may be largely homogeneous and substitutable across firms, promulgated by publicized ‘best practices’. Moreover, capabilities, while constructed in a unique way for each firm, may still result in the same function across firms in these moderately changing markets. This “equifinality” (p. 1109) overwhelms the typical inimitability of path dependence.

On the other hand, markets experiencing extremely rapid, “high velocity” change (Eisenhardt & Martin, 2000, p. 1111) demonstrate shifting structure and blurred boundaries. In these markets, it is difficult to ascribe causal connections between a business model and the firm’s performance. Existing knowledge is quickly mooted, even becoming a handicap that unproductively anchors decision-making in prior experiences. Dynamic capabilities in these markets cannot rely on entrenched routines, but instead are simplified, providing guidelines and boundaries instead of rigid rules.

Given their loose “semi-structure” (Eisenhardt et al., 2010, p. 1264), these ambidextrous routines in high velocity markets balance the tension between flexibility and efficiency, and between exploration and exploitation (O’Reilly & Tushman, 2008). Yet, the outcomes are unpredictable and causally ambiguous.

Thus, the type of environment that some or all of the startups propose to enter may cause the lack of a significant relationship between the number of hypotheses validated by a team and its venture’s success. Those in sectors that change moderately quickly might find greater utility in a formulaic, sequential routine of hypothesis testing. In contrast, an overly formulaic process might undermine venture results in a high-velocity context.
Finally, some entrepreneurs may already have experience with the target customer segment such that their initial hypotheses are already close of customer demand. Or the entrepreneur may have already tested and validated some hypotheses prior to entering the accelerator program upon which our sampling is based. This would mean that exogenous factors influence the relationship between the number of validated hypotheses and the venture’s success.

**Business Models**

Phase Four of this research finds that no single element of the Business Model Canvas, when used as a categorization framework of validated hypotheses, explains a significant portion of the variance of team performance. There are several possible explanations for this.

First, teams labeled the hypotheses by categories themselves. In this author’s personal teaching experience, some students misconstrue the descriptions of some of the elements. For example, the Key Resource element often contains hypotheses around the hard assets that would be necessary for the firm to commence and then operate at scale. However, when originally created, Osterwalder (2004) cited the Resource-Based View of the firm, suggesting that this element should emphasize hypotheses around resources that would be valuable, rare and inimitable. Similarly, students often enumerate mundane tasks in the Key Activities elements. Osterwalder’s (2004) initial discussion of this element emphasized the Activity Systems view of business models (Zott & Amit, 2010), which focuses on those boundary-spanning operations that novel, encourage lock-in, accrue complementarities, and optimize efficiency. The method of and data for Phase
One disallow verification that the teams categorized hypotheses according to the strict
definition of the Canvas.

A second possible explanation is that the Canvas is not a useful tool for nascent
entrepreneurs to envision their startups. Derived from literature instead of empirics, this
framework may not accurately and reliably capture the logic by which firms create and
capture value. This view, however, seems extreme. A more realistic variant is that the
Canvas is indeed an accurate—and perhaps even exhaustive—framework that epitomizes
all of the components of a business model, but perhaps an exhaustive definition is not an
efficacious tool for nascent venture. It is feasible to assume that some parts of the
business model have a greater impact on success, either through all stages of venture
development or at least in the early stages of conceptualization.

Our cluster analysis from Phase One supports this latter view. Teams who
validate a higher number hypotheses in the elements of customer segment, value
proposition and channel generate ventures that perform significantly better than teams
who validate only a few hypotheses in all three of those elements. This suggests that
these three particular of elements, when used in conjunction with each other, support
success. This cluster pattern is also supported in the literature (Abell, 1980). This
conclusion opens a new line of inquiry for research into business models: which elements
are more important, to whom, and when?

The statistical non-significance of several elements within the Business Model
Canvas prompts Research Question Four, which asks how practicing entrepreneurs
within our sector of interest define and prioritize their own business models. Phase Four
of this dissertation adopted grounded theory to build a framework from primary
interviews. Our finding diverges in several places from the elements within the Canvas. These discrepancies share a common theme: they embed the business model into its marketplace with a specificity and diligence that is absent from the Canvas. For example, we found that social networks—a factor that is not explicitly included in the Canvas—play a central role in marketing, distribution and post-sale service, as well as a connection between product and market, venture and consumer. This theme implies that the contemporary definitions of a business model neglect context, perhaps in an effort to generalize through abstraction. We contend that even an abstracted, generalizable framework can still include starker, explicit linkages between business model and marketplace. Business model elements like social networks, mental models, or existing product constellations are not unique to cleantech ventures at the Base of the Pyramid. They can offer increased explanatory and predictive power to the definition of business models across other industries.

**Activities**

Research Question Two relates to the activities that nascent entrepreneurs can implement to collect evidence as part of their hypothesis testing. This aligns with our over-arching goal of exploring the existence of a repeatable, specific recipe that would comprise an entrepreneurial dynamic capability. Our finding that customer interaction is conducive to eventual venture success aligns with the literature. Direct interviews with potential customers generate evidence that can be directly used to validate or invalidate a hypothesis.

The low significance of experimentation may suggest that this activity is not constructive in the formulation of a new venture’s business model. We contend, however,
that this finding emanates from low variance within our sample: most of the teams created a prototype and ran some kind of experiments with their proposed customers.

A third finding from Phase Three is that customer interaction and experimentation, when performed together, reduce the venture’s likelihood of success. Even though they are posited to be complements to each other, we find that they are substitutes in our sample. There are several different alternatives to explain this outcome. First, of course, is the possibility that this conclusion, too, results from low variance in the constructs and is therefore statistically suspect.

A second possibility is that sequence matters. The literature around the Lean Startup Method (Ries, 2011) posits that customer interactions should precede experimentation, presumably because the former provides rough, global possibilities for optimization whereas the latter offers granular local optima. A team that conducts experiments prior to customer interaction may be prematurely and deleteriously reducing the search space for its potential business model. Because our dataset does not include information on the sequence in which the entrepreneurial teams within our sample performed these two activities, it is possible that there was a mixture of sequences, thereby confounding the statistical relationship. This possibility highlights the need for additional clarity into the importance of sequence for activities to collect evidence for hypothesis testing.

A third possible explanation for the relationship between customer interaction and experimentation as they relate to venture performance refers back to the empirically higher amount of optimism inherent to entrepreneurs. Although this optimism leads to elevated instances of confirmation bias (which are potentially and intentionally
overwhelmed by hypothesis testing), it is nonetheless a vital ingredient in successful ventures, as it provides the founders with the emotional resilience to weather the challenges related to starting a new business that are not typically experienced by non-entrepreneur business professionals. It possible that the combination of customer interaction and experimentation generate so much data, including invalidated hypotheses and therefore changes to the business model that must be re-tested, that the founder is dispirited. Her essential optimism is worn away. As a result, she may quit the venture or generate lackluster performance. This possibility could be further explored in the entrepreneurial literature by determining if there are thresholds for evidence gathering, where more collection may still provide a small marginal benefit of validation for hypotheses but would impose a large marginal cost of the emotional resilience of the entrepreneur.

Cognition

The possibility that optimism may explain some of the findings in Phase Two of this research prompted Research Question Three, which empirically explored the relationships between the cognitive and behavioral traits of the entrepreneurs conducting these activities and the predominance of those activities. We seek to find the microfoundational antecedents to customer interaction and experimentation. (It is important to note that this analysis did not attempt to evaluate the connection between traits and venture success. This well-worn path has repeatedly found mixed results.) Only one trait was found significant: people who score highly for conscientiousness are more likely to practice the activity of experimentation.
This finding might be explained by the nature of experimentation: first, experiments are constructed before they are executed. An experiment is rarely extemporaneous. Further, the results of the experiment are only valid and useful when the procedure for conducting the experiment is followed in the same way for many repetitions. Changing the administration of the experiment for each respondent invalidates the utility of the exercise. This adherence requires consistent attention to detail. Such consistency is therefore likely to appear in the psychological makeup of the entrepreneur, exhibited not just in the pursuit of venture conceptualization but across other circumstances as well. Founders are more likely to practice the activity of experimentation to collect evidence for hypothesis testing if they are already conscientious.

None of the other Big Five personality traits are significant to the practice of these two activities. Moreover, improvisation, a behavior that has been linked in the extant literature to entrepreneurial intention and success, does not show significant relationships to either the antecedent traits or the consequent activities. This finding can be explained in several ways. First, it is possible that the composition of traits across all members of the team does indeed connect traits to activities. For example, while a leader may not require a trait such as openness to new information to generate a successful venture, such a trait might be necessary for success within a member of the founding team. Our analysis does not allow for the examination of this possibility because we only considered the traits of the leader.

The second possibility is that the likelihood of engaging in the activities of customer interaction and experimentation to collect evidence for hypothesis testing is not
bounded by openness, extroversion, agreeability, neuroticism or improvisation. This conclusion has several implications for entrepreneurship. It eliminates the possibility of using personality filters to preemptively select for entrepreneurs that would have a greater likelihood of success. It also reduces the importance of creating, adapting or avoiding entrepreneurial dynamic capabilities based on personality type. This suggests that, with the exception of conscientiousness as an antecedent for experimentation, the entrepreneurial dynamic capability of hypothesis testing does not have any cognitive preconditions.

The following chapter describes the implications of these findings on our research question and the study of entrepreneurship.
CHAPTER 7: CONCLUSION

The overarching aim of this stream of research is to examine a repeatable routine that would assist entrepreneurs in conceptualizing their venture idea in order to improve their chance of commercial success. From these four studies, this dissertation concludes that validation of nascent venture’s proposed business model through customer interaction and experiments improves its chance of success. Our first task in this chapter is to apply our findings to the gaps in the literature to resolve our research questions.

Entrepreneurial Dynamic Capabilities

As discussed above, extant literature has not yet empirically explored the applicability of dynamic capabilities to nascent entrepreneurs in the process of conceptualizing a business model. While the Lean Startup Method provides tactical procedures that might qualify as dynamic capabilities, this approach also lacks empirical support. This research stream provides this empirical support. We conclude that a repeatable heuristic routine of hypothesis testing explains some of the variation in subsequent venture success.

However, as expounded in theory (Eisenhardt & Martin, 2000), dynamic capabilities may be context-specific and their repeated utility for firm performance may erode in highly volatile markets. Moreover, some founders may begin the process of refinement with hypotheses that are already based on evidence, and therefore might require fewer iterations to achieve validation. These factors converge to reject the proposition that more iterations of the dynamic capability produce a concomitant linear elevation in firm performance. This conclusion provides a boundary condition for the application of the theory of dynamic capabilities to nascent entrepreneurship.
**Business Models**

The existing literature described above on business models asserts definitions, models, and frameworks to describe, explain, and predict the logic by which a firm creates and captures value. One such framework, the Business Model Canvas, is proposed as a heuristic to simplify the elucidation of a firm’s business model into nine vital elements, where categorization of hypotheses into these elements would improve venture performance. We conclude that this claim is not supported by empirical results: not all of its nine elements are vital for venture success, at least in the early stages of conceptualization. However, we do conclude that emphasis by entrepreneurs on validating hypotheses within a subset of these elements explains some of the variation in venture performance. This conclusion, moreover, suggests that theories of business models may differentially apply to firms in different stages of development.

This latter conclusion is affirmed by another piece of this research stream, which concludes that firms that have already conceptualized, tested, launched, executed, and even fine-tuned their business models with evidence from actual, paying customers conceive of a business model in still a different way than theory expects. They embed their business models deeply into the context of their market places, leveraging mental models, networks, and channels in ways that are not apparent from contemporary theory.

**Activities**

The dynamic capability of hypothesis testing can be comprised of different activities to collect new information as discussed above. Just as the larger theory of capabilities lacks empirical evidence when applied to the conceptualization of nascent entrepreneurship, so too are there unresolved questions about the efficacy of the activities...
that comprise this capability. We conclude that customer interaction explains some of the variance in subsequent venture performance. Experimentation does not, but we concede that this might be a methodological idiosyncrasy. However, we find that conducting both of these activities together undermines performance, perhaps due to the erosion of essential entrepreneurial optimism. This conclusion highlights the possible impact of entrepreneurial cognition in the execution of this dynamic capability.

**Cognition**

As described above, there are several gaps in the literature on entrepreneurial cognition. Most importantly, despite the theoretical and empirical literature that connects entrepreneurial cognition to venture success, not much work has been done on finding relationships between entrepreneurial cognition and the activities within hypothesis testing. We conclude that conscientiousness is a microfoundational antecedent to experimentation. However, we find no other significant personality traits or predilections for improvisation that similarly precede experimentation or customer interaction. This latter conclusion suggests that the entrepreneurial dynamic capability of hypothesis testing is not limited to entrepreneurs within narrow personality types; it can be useful to a larger swathe of the population.

In summary, this research stream contributed to the academic literature by addressing several gaps in the extant literature. Furthermore, this research has broader implications for the study of nascent entrepreneurship. The following section of the dissertation describes these implications. It then enumerates the limitations of our four phases, followed by suggestions for future research to shed additional light on our problem of practice.
Implications to the Study of Entrepreneurship

First, this study demonstrates that the literature on dynamic capabilities, which was born in corporate strategy, can make a contribution to entrepreneurial ventures. Similarly, by providing evidence of the impact of the specific dynamic capability of hypothesis testing, as well as support for specific activities of customer interaction and experimentation for gathering evidence during this process, this paper also uses entrepreneurial endeavors to provide additional explanatory and predictive power to research on corporate strategy. We are not just extending the theory of dynamic capabilities to entrepreneurship. Some of our conclusions can be extended to business professionals who are creating any new product, service, or program (subject to some limitations discussed below). Corporate marketing managers exploring a new ad campaign or accountants considering refinements to an existing service could focus on customer interaction to improve their likelihood for success. Such customer-focused activities might displace prominent strategies for established firms, echoing the work of Christensen and Bower (1996) and McGrath and MacMillan (1995). Instead of borrowing theories from the realm of strategy, the field of entrepreneurship is contributing theories, data, and evidence to the field of strategy (Morris et al., 2005), a sign of the maturity of entrepreneurial research.

Second, proponents of deliberately emergent approaches such as the Lean Startup Method have based their support on intuition and anecdotes. This paper provides statistically significant empirical analysis to the debate about optimal conceptualization approaches to aid in the iterative improvement of this popular approach.
Third, this research reveals several boundary conditions on the theory of dynamic capabilities: diminishing returns to hypothesis testing and customer interactions and alternative priorities and elements for constructing a business model. The elucidation of boundary conditions contributes to theory in three different ways. First, it highlights the circumstances under which the theory is valid and therefore we can make predictions with confidence, and similarly the circumstances under which it is not valid and therefore where predictions are suspect. Second, it notes when two different theories clash. For example, in this dissertation, our results suggest that dynamic capabilities may erode essential optimism such that venture success may suffer from the excessive use of these routines. The cognitive aspects of performative routines may overwhelm the efficiency and legitimacy offered by ostensive routines. Third, it prompts researchers to evolve the theory to account for these outliers. Subsequent iterations of dynamic capabilities might incorporate aspects of cognition in order to improve the theory’s explanatory and predictive power.

For the fourth implication of this research, by focusing on the antecedents of activities within this dynamic capability of hypothesis testing (specifically within Phase Three), a portion of this research diverges from the typical emphasis on venture success to consider the microfoundations of the capability. This line of research aids in the study and improvement of entrepreneurial activities that have been linked generally to venture success, even if those activities might not generate venture success in a single circumstance. This distinction is important: as a body of researchers, we have been accused of focusing too much on processes that might generate a stellar venture, and
focusing too little on processes that would make a contribution to all ventures, even those with more modest opportunities and ambitions.

Fifth, the study of business models has sought an exhaustive rigorous definition. This dissertation introduces the possibility that different aspects of this definition are more important at different times during the evolution of a venture from concept to product offering. This opens a new line of academic and practical inquiry within this literature.

Moreover, investors can better predict and improve the success of the start-up ventures within their portfolio by understanding the routines that founders should follow in order to increase their chance of success. This contribution ties academic research to practical outcomes, and ties venture practice with venture financing.

In addition, by verifying and extending a repeatable routine, including the activities to collect evidence and the aspects of the business model that merit initial attention, this dissertation makes a contribution to practicing entrepreneurs. Validating hypotheses around customer segmentation, value proposition and channel distribution through customer interaction and experimentation increases the likelihood of the venture’s success.

Finally, this increase in venture success would not only be important to the founding entrepreneurs, but also to the customers they intend to serve. Many cleantech ventures provide low-carbon energy to impoverished customers at the bottom of the world’s economic pyramid who are living on less than $2 per day. Successful ventures improve the quality and longevity of life for people on our planet most in need of
assistance. By reducing carbon emissions, these ventures also address global environmental challenges.

**Limitations**

The specific phases within this dissertation each have limitations as described in the individual papers in the appendices. Moreover, the research design of the entire research stream also has some weaknesses.

First, because three of our four phases are quantitative, we test propositions about the nature and influence of constructs for which we have data. We do not test the influence of constructs outside of our narrow propositions. There may be several other capabilities, activities, and frameworks that entrepreneurs might profitability employ to improve an initial venture concept. For example, it is possible that capabilities around team formation and early leadership practices have a larger impact on long-term venture success than hypothesis testing. This steam of research does not compare many of these alternatives. As a result, the mixed method design, which was employed to triangulate towards a more reliable answer, may instead compound the research’s initial assumptions (Jick, 1979).

Second, our research makes several assumptions about the linear sequence of traits, practices, activities, and outcomes within the process of hypothesis testing. Although supported in literature, this sequence may not be linear. For example, an entrepreneur’s learning style, a scale that is loosely related to the Big Five psychometric traits used in this research (Busato, Prins, Elshout, & Hamaker, 1998), may both inform and be molded by the type of conceptualization activities that the entrepreneur considers. In other words, there may be feedback loops that merit examination.
Third, research generates theories that are abstracted from the specific circumstances of the sample under scrutiny. Such abstraction intentionally generalizes the findings in order to apply them to other circumstances. Yet this generalization may undermine the theory’s nuance or use of context. The conclusions from this dissertation may only apply to cleantech ventures, to concept formulation within an accelerator program or to small teams of entrepreneurs. Of particular concern is the proxy for success used in Phases One and Two in this paper: performance in a venture pitch competition at the conclusion of the three-month accelerator program, where success is measured a panel of judges with expertise in the sector. This metric certainly reduces the influence of many exogenous variables that would impact venture success to highlight the relative importance of concept formation. However, it also neglects to consider many other aspects of nascent entrepreneurship, including raising investment, hiring, intellectual property protection, or business operations.

A fourth related limitation is the focus of this research on nascent entrepreneurship to the exclusion of the routines that might assist managers in established companies with constructing and testing business models for new products. Existing ventures already have evidence that supports their initial hypotheses in the form of sales, whereas nascent entrepreneurs considering new ventures have neither the evidence nor the inertia that comes with it. It is possible, therefore, that the dynamic capabilities that generate success with “greenfield” ventures may not perform similarly for the conceptualization of “brownfield” ventures.

A fifth limitation is related to this same proxy for success. This research tests several components of the Lean Startup Method. The approach’s popularity among
practicing entrepreneurs and academia makes such testing urgent. However, the approach’s popularity may also compel judges to look for aspects of the Lean method, even before they have been related to long-term venture success. In other words, our dependent variable’s measure for success may already be endogenously intertwined with our independent variables.

Finally, we assume that invalidated hypotheses are revised, reconstructed and retested until validation is achieved. This process drives the reconfiguration of resources. This is the foundation of the efficacy of dynamic capabilities. Our research assumes this action, but our data and methods do not provide direct evidence of this reconfiguration.

**Future Research**

Several of these limitations can be overcome with additional research. First, longitudinal studies of the venture teams within the accelerator program can analyze the connection between success in the competition and commercial success several months and years after the competition.

Second, as noted above, the area of venture conceptualization heretofore has a dearth of reliable scales to capture the variance and nuance of entrepreneurial actions. For example, there are several possible ways to design and conduct experiments, from randomized controlled trials to field observations of choice architecture. The distinctions between these variants may have large impacts on analyses of venture success.

Third, the hypotheses within these four phases of research can be developed and tested for other samples beyond the cleantech sector to verify the generalizability of our conclusions to other industry sectors with different characteristics. Because venture
conceptualization is often the subject of online seminars, this field of research may have interesting opportunities for additional analysis with data from online courses.

Fourth, in Phase Three, we found that the behavior of improvisation was not a significant antecedent to the activities of customer interaction and experimentation. However, the search for other microfoundational behaviors may yet yield fruit. This would generate benefits both for researchers in understanding the underlying cognitive and behavioral patterns upon which hypothesis validation relies. It would also generate benefits for practicing entrepreneurs. Providing them with a set of skills prior to their embarkation on an entrepreneurial venture would not just improve the success of ventures, it would also improve the broad-based success of serial entrepreneurs.

Finally, future studies should observe the direct impact of hypothesis testing on the reconfiguration of resources of the firm. This could be accomplished through deeper qualitative and quantitative analysis of changes to a nascent venture’s business model as a result of validation and invalidation. This would empirically verify the link between the capability and dynamism.

**Reflections as a Researcher**

The diagnoses of limitations within this research and the prescriptions for future research to address these limitations emanate from perfect hindsight. My own journey as a researcher has contributed to some of these limitations. This final section of my dissertation describes some of the lessons from own journey and their impact on my research agenda.

The initial project of this research stream was the qualitative examination of the way that practicing cleantech entrepreneurs characterize and prioritize their own business
model. It introduced me to the literature on business models. However, I arrived to the project with the expectation that I would determine which aspects of the Business Model Canvas were most important to nascent entrepreneurs. I did not anticipate that these entrepreneurs used almost none of the Canvas elements. This pattern repeated itself in the other phases: the outcomes of each individual project were surprising and led in new directions.

Moreover, my grasp of the relevant literature deepened over time. This precipitated a change to the “frame” within which this research is integrated. Prior themes included business modeling, the Lean Startup Method, and entrepreneurial bias. These are intellectually interesting, but situated in small audiences and already well researched. There are only a few remaining gaps. This limited research opportunity was illustrated in the third paper on microfoundational antecedents. The selection of the Big Five personality traits was an unfortunate maneuver. This was already well-trod ground. In retrospect, it is unsurprising that I found few significant paths in that research paper. Consideration of other constructs such as proactivity or nonconformity may have been more fruitful.

The decision to embed this dissertation into the strategy literature around dynamic capabilities did not gel until three of the four phases had already been written. This late change required some post facto reframing of the order in which the individual papers contribute to the whole. Phase one of this dissertation about hypothesis testing was in fact the last study conducted chronologically. And phase four about embedded business models was chronologically conducted first.
I do not regret these late changes. It certainly required more effort and reduced the quality of the final product than if I had followed a predetermined plan from the outset. But it also allowed for a more interesting intellectual journey and a wider coverage of potential topics that might be relevant to the heuristics of venture conceptualization.
APPENDIX A: IS BUSINESS MODEL VALIDATION VALID?

ABSTRACT

As anticipated in entrepreneurial literature, the validation of hypotheses around a proposed venture’s business model generally contributes to venture success in 185 teams in a cleantech accelerator program. However, there is no relationship of success to the number of validated hypotheses or to the element of the Business Model Canvas being tested. Concurrent emphasis on customer segment, value proposition and distribution channel, however, more than doubles the likelihood of venture success. This research highlights the distinction between a complete theory of a business model and a useful tool for constructing a model during the nascent states of venture conceptualization.

EXECUTIVE SUMMARY

The validation of hypotheses around a potential venture’s business model is an entrepreneurial dynamic capability that reconfigures resources to increase the likelihood of its success at launch. The Business Model Canvas provides a popular framework of nine non-overlapping elements to comprehensively categorize hypotheses of a venture’s business model.

Using binary logistic regression of both dichotomous and cumulative counts of hypotheses within the Canvas, and results from a business pitch competition of 185 teams in a cleantech accelerator program, this paper finds that validation of hypotheses, in general, significantly and positively improves success. However, there is no significant connection between the number of validated hypotheses and venture performance.

Teams also categorized their hypotheses into the nine Canvas elements. No element directly contributes to success. An exploratory k-means cluster analysis suggests that
teams that validated many hypotheses within customer segment, value proposition and
distribution channel performed twice as well as teams that validated only a few
hypotheses within each of those three elements.

These findings provide mixed support for the importance of hypothesis validation as
an entrepreneurial dynamic capability to drive venture success. Moreover, they suggest
that nascent entrepreneurs should focus on a subset of business model elements, thus
creating a distinction between the theoretical definition of a business model and the tools
that are useful for its sequential construction.

**INTRODUCTION**

Few initial ideas for a new entrepreneurial venture are ideal. They contain many
unexamined assumptions, incompatible intricacies and incomplete business models.
Entrepreneurs and business managers can follow routines, called dynamic capabilities, to
iteratively improve the business concept through experiential learning (Eisenhardt &
Martin, 2000; Teece et al., 1997; Zollo & Winter, 2002) to “purposefully create, extend,
or modify [the firm’s] resource base” (Helfat et al., 2007, p. 609). One such dynamic
capability used by entrepreneurs to sense and seize new opportunities is hypothesis
testing (McGrath, 2010; Teece, 2007).

For a potential new venture, the business model is an assertion of the composition and
configuration of resources and activities within and across the boundaries of the firm
(Zott, Amit, & Massa, 2011) by which a firm creates and captures value (Morris et al.,
2005). The Business Model Canvas (Osterwalder & Pigneur, 2010) provides a popular
normative description of nine non-overlapping elements of a business model: customer
segmentation, value proposition, channel, customer relationship, revenue stream, partnerships, activities, resources, and cost structure.

This paper empirically explores the importance of hypothesis testing for each of the elements of the Canvas to eventual venture success. This analysis highlights the elements that should garner early attention from entrepreneurs as they clarify their proposed venture’s business model. The data emanate from the activities of 185 teams in a cleantech accelerator program as recorded by a web-based tool for tracking the codification and validation of hypotheses through customer feedback. At the conclusion of the three-month program, all of the teams enter a pitch competition where a panel of experts granted awards based on their assessment of the ventures’ potential for success. The data were analyzed with binary logistical regression and cluster analysis.

We find that the validation of hypotheses, in general, significantly and positively improves success. However, there is no significant connection between the number of validated hypotheses and venture performance. Moreover, the validation of hypotheses, according to the Business Model Canvas, shows no significant relationship to venture performance; none of the nine elements predict success. A cluster analysis, however, suggests that teams that validated many hypotheses within customer segment, value proposition and distribution channel performed twice as well as teams that validated only a few hypotheses within each of those three elements.

This paper is organized as follows. A review of extant relevant literature provides context and testable propositions for both the entrepreneurial dynamic capability of hypothesis testing and business model composition. The section on methods describes the sample, data collection, and data screening. A report of empirical results is followed by a
discussion relating these results to the literature. The conclusion of this paper describes the implications of these findings, along with the limitations of the analysis and opportunities for future research.

**LITERATURE AND HYPOTHESES**

A hypothesis is a falsifiable statement (Popper, 1959) that can be examined with evidence to confirm or reject its veracity in the extant circumstance. The use of evidence to confirm or reject hypotheses improves firm performance in general (Rousseau, 2006) and the likelihood of success for an entrepreneurial venture in specific (Blank, 2006, 2013). Moreover, “validated learning is the process of demonstrating empirically that a team has discovered valuable truths about a startup’s present and future prospects” (Ries, 2011, p. 39).

Hypothesis testing overcomes the founder’s bias to select evidence that confirms pre-existing expectations (Klayman & Ha, 1987), a problem common in entrepreneurs (Busenitz & Barney, 1997; Nickerson, 1998). A declaration of validity for each hypothesis demonstrates that potential customers support that aspect of the future business. This improves the likelihood that the venture will appeal to these customers upon launch. An entrepreneur that validates more hypotheses about its venture concept has confirmed more of the details and nuances of the model, and is therefore more likely to be commercially successful than an entrepreneur who has confirmed only a few.

The theoretical support for hypothesis testing implies but does not state that more testing leads to better results. It is possible that the action of testing any hypotheses during venture conceptualization demonstrates an adherence to this process. Moreover, experienced entrepreneurs may posit initial hypotheses that are already based on
substantial prior knowledge about customer expectations. These hypotheses would not require repeated iterations. This paper therefore analyzes hypothesis testing from two perspectives: first, where any testing demonstrates adherence to the process, and second, where testing more hypotheses implies a higher likelihood of uncovering customer appeal.

*Proposition 1:* There is a positive significant relationship between a venture’s eventual success with a) the achievement of at least one validated hypothesis and b) the number of validated hypotheses.

**Business Model Elements**

The propositions described above are not specific to the specific aspects of the proposed venture. A more granular approach examines the impact of hypothesis testing on the specific elements of the business model, as defined by the Business Model Canvas (Osterwalder & Pigneur, 2010). The canvas contains nine elements:

*Customer segments* (CS) are comprised of groups of paying customers with common needs and attributes. There are several different types of approaches to customer segmentation: niche, segmented along a continuum, diversified, and multi-sided. A single product or service can have multiple target segments, but they are usually prioritized. If deliberately selected and pursued by the entrepreneur, this segmentation and prioritization form the basis of the firm’s corporate strategy (Porter, 1980) and marketing approach. (Alternatively, according to Porter, a firm might aim to become the low-cost provider. This strategy would be capture in the *cost structure* element described below.)

The *value proposition* (VP) is more than just a description of the product or service, but also an articulation of the benefits of the service as it addresses the needs of the
various customer segments. Typical propositions include quality, performance, design, or impact on status. Both the *value proposition* and the *cost structure* capture details about the technologies employed in the product or service.

*Channels* (CH) refer to the method by which the venture interacts with the customer to deliver the product or service. These may be the firm’s own communications, sales, or distribution channels, or those of a partner. Through these channels, the firm establishes a *customer relationship* (CR), defined by the context that the firm aspires to build around the specific business transactions, ranging from personal one-to-one contact through co-creation with customer communities to automated self-service.

*Revenue streams* (R$) are the one-time or recurring transaction of cash from the customer to the firm based on an asset sale, usage fee, subscription, lease, license, commission, or advertising. This element includes the pricing mechanism, which can range from fixed prices, sometimes specific to product feature or customer segment, to dynamic prices through negotiation, market conditions, or auctions in order to maximize profitability or yield.

The *key resources* (KR) within the firm refer to the physical, intellectual, human, and financial capital that support the firm’s *key activities* (p. 36) to produce the good or service, solve problems, or construct the platforms that underlie the firm’s value proposition. These *key resources* include leadership and organizational structure. In a study of 24 different firms, Stuart and Abetti (1987) concluded that the leadership traits of the entrepreneur was positively correlated with performance. In a study of 1,053 firms, Cooper et al. (1994) found that various types of human capital contributed differentially to start-up performance, but that injection of financial capital consistently improved
venture performance. These *key resources* might also factor into the entrepreneur’s venture strategy, as the basis for core competence or other resource-based views of the firm, as discussed in more detail below.

The element of *key activities (KA)* is comprised not just of the functions and processes within the firm, but also the externally imposed constraints and incentives from government regulation.

Due to advances in communications technology, firms are increasingly establishing *key partnerships (KP)*, including alliances, joint ventures, and integrated buyer–vendor relationships, in order to optimize production, achieve economies of scale and scope, reduce risk, and extend their own capabilities beyond their internal resources. This element of the canvas also captures external forces within the firm’s environment that define the dynamism of the venture’s market, including the actual and potential impacts of suppliers, customers, new entrants, and intra-industry rivalries.

These resources, activities, and partnerships dictate a *cost structure (C$)* for the firm.

This ontology is supported by existing research (Osterwalder, 2004) with the assertion that each of the elements is vital to a complete, aligned, successful business model. (A review or critique of the theoretical foundations of this framework is beyond the scope of this paper.)

As with Proposition One, there are two measures of validation: one where the team has validated any hypotheses whatsoever (a binary variable) and another that uses the raw counts of validated hypotheses to suggest that more validated hypotheses in linearly related to the likelihood of venture success. We capture these alternatives in the following proposition.
Proposition 2: Teams that validate hypotheses more within each element of the Business Model Canvas perform better than teams that validate a) no hypotheses or b) only a few hypotheses.

Finally, the Canvas theorizes nine elements that comprise an exhaustive definition of a business model. However, during conceptualization of a venture, only a few of the elements are important to determine adequate fit with the potential target market: who will benefit (customer segment), how they will benefit (value proposition), and how they will receive the benefit (channel) (Abell, 1980). In other words, the sequence of the validation of a business model is relevant for nascent entrepreneurs.

Proposition 3: The cluster of cases with a high number validated hypotheses for customer segmentation, value proposition and channel generates better venture success than a cluster with low numbers of validated hypotheses in these three elements.

METHODS

This section describes the method by which we tested these propositions, including the sample and data collection method. We also describe some of the variables within the dataset.

Sample

This study analyzes the actions and outcomes of 271 teams that participated a cleantech accelerator program in 2013 and 2014. The program was founded in 2005 to promote entrepreneurial businesses that would commercialize technologies to generate clean energy and clean water (“cleantech”), often for consumers at the base of the
world’s economic pyramid. The program has grown steadily each year in geographical reach, participation, and notoriety.

Upon acceptance into the accelerator program, teams were introduced to and encouraged to use a free online tool that tracks the team’s activities during the three-month period. This tool encourages the team to record the number and substance of each hypothesis, categorized by element within the Business Model Canvas. It also encourages the team to record the number and substance of each customer interaction, as well as an interpretation of the impact of the interview on the validity of the enumerated hypotheses. The dataset used in this research article contains the count of validated, invalidated, and unresolved hypotheses for each Canvas element.

These terms were not specifically defined within the software tool. After each interview or experiment, the entrepreneurs declared if a customer interaction supported or rejected an existing hypothesis. If rejected, participants were asked if the entire hypothesis was invalid, and therefore in need of reconstruction and retesting. The participants therefore provided their own definitions and thresholds for validation and invalidation.

The dataset does not contain any time stamp, sequence or pattern of by which these hypotheses were created or assessed. Nor does it contain any information about the content within the hypothesis, and therefore has no insight into the significance of the differences between hypotheses.

At the conclusion of each year’s program, teams in each region compete by publically pitching their venture concepts to a panel of judges. Winners are provided with awards and investment towards the launch of their business concept. This study treated the
awards as a dichotomous dependent variable (winner or loser) instead of an ordinal variable because such granularity of the ranks implies that the experts could reliably predict the comparative performance of cleantech ventures that might be entering adjacent markets.

This sample is well suited to test these hypotheses for several reasons. First, these teams are all within the same narrow industrial sector: technology aimed at generating clean energy or clean water. As a result, they are subject to similar external market trends, allowing us to reduce the number of external factors that might differentially impact our subjects.

Second, the teams within this accelerator program are all at a similar stage of venture development. Acceptance into the accelerator program requires that applicants submit venture concept, which is evaluated by the accelerator’s staff for initial commercial potential, but have not earned more than $100,000 in gross revenue or raised more than $1,000,000 in investment prior to their application. Thus, the members of this sample all belong to nascent startup ventures. None is a division of an existing corporation.

Third, the entrepreneurs within these teams have similar ambitions. Because the three-month program is time consuming, these entrepreneurs are not pursuing this idea on a whim. They are not students engaged in an academic exercise. Because the prize for winning the venture competition at the conclusion of the accelerator program is $200,000, we also assume that the participants are not experienced entrepreneurs with successful exits that might allow them to forgo the hurdles and benefits of an accelerator program.
Screening

The data from the online tool about hypothesis testing contained 26 cases that could not be traced to teams in the accelerator program. These teams may have been misidentified, or may have dropped out of the program prior to the competition. They were excluded from the analysis.

The data from the accelerator program about competition awards listed 42 cases that were not in the dataset from the online tool. These were added to the analysis, but with a value of zero for each of the variables within the tool. As a result of these two steps, the results may under-report the contribution of the tool to venture performance.

Data Description

Eighty-six teams within the accelerator program did not enter any data into the tool. These include the 42 cases for which there is no data whatsoever, and an additional 44 teams that created an account within the tool but did not enter a single hypothesis. These teams are considered “inactive”. In contrast, a team that inserts at least one value in at least one field of the tool is labeled as “active”. Of 271 teams across both 2013 and 2014, 185 were active in the online tool (Table A1).

Table A1: Sample Details by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Teams in accelerator</th>
<th>Active accounts in tool</th>
<th>% Active of all participants</th>
<th>Winners among participants</th>
<th>% of winners of all participants</th>
<th>% of Active winners of all participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>139</td>
<td>72</td>
<td>51.8%</td>
<td>31</td>
<td>22%</td>
<td>43%</td>
</tr>
<tr>
<td>2014</td>
<td>132</td>
<td>113</td>
<td>85.6%</td>
<td>21</td>
<td>16%</td>
<td>19%</td>
</tr>
<tr>
<td>Total</td>
<td>271</td>
<td>185</td>
<td>68.3%</td>
<td>52</td>
<td>19%</td>
<td>28%</td>
</tr>
</tbody>
</table>

The categories are summarized in Table A2. (Note: the label of “loser” for those who did not win a regional award is not intended to be pejorative, but merely concise.)
Table A2: Active and Winning Categories

<table>
<thead>
<tr>
<th></th>
<th>Active</th>
<th>Inactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winner</td>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td>Loser</td>
<td>56%</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>68%</td>
<td>32%</td>
</tr>
</tbody>
</table>

Table A3 reports the averages for each of the 40 variables without the dataset across all participants (including active and inactive accounts). In addition, these 271 teams conducted 2,596 interviews, or an average of 9.6 interviews across all participating teams, or an average of 14.0 interviews across teams with an active account. Of all codified hypotheses, 17% were validated, 6% were invalidated and the remaining 77% were unresolved.

Table A3: Average Number of Hypotheses for Each Canvas Element

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>CS</th>
<th>CR</th>
<th>CH</th>
<th>VP</th>
<th>KA</th>
<th>KR</th>
<th>KP</th>
<th>C$</th>
<th>R$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codified</td>
<td>25.5</td>
<td>5.0</td>
<td>2.7</td>
<td>2.6</td>
<td>4.6</td>
<td>3.2</td>
<td>3.0</td>
<td>4.7</td>
<td>3.1</td>
<td>2.5</td>
</tr>
<tr>
<td>Validated</td>
<td>4.4</td>
<td>0.6</td>
<td>0.4</td>
<td>0.3</td>
<td>0.7</td>
<td>0.5</td>
<td>0.5</td>
<td>0.7</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

RESULTS

Of the 271 teams in the cleantech accelerator, some of whom did not use the online tool, 19.2% won an award in the competition in 2013 or 2014. Of the 185 active users, 18.6% won an award. There is no significant difference in venture success between active users and all participating teams (p>.62).

Hypothesis Testing

The bivariate correlation between the presence of validated hypotheses and venture success is positive (.200) and significant (p<.01). A binary logistic regression achieves adequate model fit (p<.01) to find that teams that performed any hypothesis validation are
2.9 times more likely to win an award than teams that do not validate any hypotheses (p<.01). However, there is no significant relationship (.111, p<.15) between the raw count of the total number of validated hypotheses and venture success. This conclusion is confirmed with a binary logistic regression. These findings support Proposition 1a but reject Proposition 1b.

**Business Model Elements**

For the 185 teams of active users of the online tool, the presence of validated hypotheses in several elements of the Canvas show positive significant correlations to venture success (Table A4 and A5): CS, VP, KA, and KP. The other elements are positive but nonsignificant. A binary logistic regression model of the presence of any validated hypotheses by Canvas element shows near-adequate model fit (p<.09) but no significant relationships to venture success.

<table>
<thead>
<tr>
<th>Table A4: Correlation of Dichotomous Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>CS</td>
</tr>
<tr>
<td>CR</td>
</tr>
<tr>
<td>CH</td>
</tr>
<tr>
<td>VP</td>
</tr>
<tr>
<td>KA</td>
</tr>
<tr>
<td>KR</td>
</tr>
<tr>
<td>KP</td>
</tr>
<tr>
<td>C$</td>
</tr>
<tr>
<td>R$</td>
</tr>
</tbody>
</table>

*p<.05, **p<.01

A second model with the number of validated hypotheses by Canvas element shows only one significant bivariate correlation: CS. A binary logistic regression demonstrates inadequate model fit (p<.393) and no significant relationships to venture success.
Table A5: Correlations of Raw Counts of Variables

<table>
<thead>
<tr>
<th>Element</th>
<th>Success</th>
<th>CS</th>
<th>CR</th>
<th>CH</th>
<th>VP</th>
<th>KA</th>
<th>KR</th>
<th>KP</th>
<th>C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>.159*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>0.045</td>
<td>.682*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>0.086</td>
<td>.664*</td>
<td>.746*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VP</td>
<td>0.098</td>
<td>.695*</td>
<td>.687*</td>
<td>.637*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KA</td>
<td>0.115</td>
<td>.703*</td>
<td>.717*</td>
<td>.662*</td>
<td>.774*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KR</td>
<td>0.073</td>
<td>.720*</td>
<td>.747*</td>
<td>.731*</td>
<td>.741*</td>
<td>.855*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KP</td>
<td>0.125</td>
<td>.713*</td>
<td>.643*</td>
<td>.696*</td>
<td>.661*</td>
<td>.733*</td>
<td>.740*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C$</td>
<td>0.036</td>
<td>.630*</td>
<td>.671*</td>
<td>.691*</td>
<td>.648*</td>
<td>.729*</td>
<td>.707*</td>
<td>.740*</td>
<td></td>
</tr>
<tr>
<td>R$</td>
<td>0.095</td>
<td>.683*</td>
<td>.704*</td>
<td>.724*</td>
<td>.729*</td>
<td>.710*</td>
<td>.731*</td>
<td>.682*</td>
<td>.725*</td>
</tr>
</tbody>
</table>

*p<.05, ** p<.01

From these results, we find no support for Proposition 2. In sum, when considered in the same model, none of the elements of the Business Model Canvas is related to venture success, measured either as a dichotomous variable to reflect the presence of any validated hypotheses for that element or as the raw count of the number of validated hypotheses for that element.

Clusters

A k-means cluster analysis with the standardized number of hypotheses for only customer segmentation (CS), value proposition (VP), and channel (CH) generates a cluster bifurcation such that each element is significant (p<.001) (Table A6 and Figure A1). Teams in Cluster 2 with higher numbers of validated hypotheses within these three elements report twice as much success in the venture pitch competition: 31% chance of an award compared to 15% for Cluster 1, which is a significant difference in a one-way ANOVA (F=5.85, p<.017). (A three-cluster model roughly bifurcated Cluster 2, therefore not contributing much explanation of the additional heterogeneity.)
Table A6: Cluster Analysis of Selected Elements

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1</th>
<th>2</th>
<th>F value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>-0.42</td>
<td>1.43</td>
<td>276.205</td>
<td>.000</td>
</tr>
<tr>
<td>VP</td>
<td>-0.41</td>
<td>1.40</td>
<td>248.468</td>
<td>.000</td>
</tr>
<tr>
<td>CH</td>
<td>-0.43</td>
<td>1.47</td>
<td>325.691</td>
<td>.000</td>
</tr>
<tr>
<td>Success</td>
<td>0.15</td>
<td>0.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>143</td>
<td>42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These findings support Proposition 11. Table A7 summarizes the implications of these findings for our eleven propositions.

Table A7: Summary of Findings for Propositions to Venture Success

<table>
<thead>
<tr>
<th>Proposition</th>
<th>Element</th>
<th>a) Dichotomous</th>
<th>b) Raw Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total Validated Hypotheses</td>
<td>+ *</td>
<td>ns</td>
</tr>
<tr>
<td>2</td>
<td>Business Model Canvas</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>3</td>
<td>Cluster of CS, VP and CH</td>
<td>+ *</td>
<td></td>
</tr>
</tbody>
</table>

+ positive relationship, * p<.05
DISCUSSION

These empirical results generate several implications for the validation of a new venture’s proposed business model during early conceptualization. First, teams that validated any hypotheses performed significantly better than teams that validated no hypotheses. However, teams that validated more hypotheses did not perform better than teams that validated fewer hypotheses. This might be explained by the confounding impact of entrepreneurial experience: a team with experience may have created initial hypotheses that already reflected customer demands, and thus required fewer iterations to achieve confirmation.

Second, there is no evidence that the validation of hypotheses in any one of the nine categories of the Business Model Canvas predict venture success. This does not undermine the Canvas as a normative theoretical construct to describe a business model (Kalinowski & Vives, 2013). However, the complete Canvas may have limited utility as an organizing principle for nascent entrepreneurs as they refine their venture concepts with evidence.

Instead, the validation of hypotheses within a narrower subset of Canvas elements—customer segment, value proposition, and channel—does indeed drive venture success. This conclusion implies that the different aspects of a business model are more germane during different stages of the venture’s life. In its early stages, nascent entrepreneurs should focus on and refine what, how and to whom the venture will deliver value. Presumably, later stages of venture conceptualization would consider other business aspects such as key activities and key resources for competitive advantage.
CONCLUSION

Hypothesis testing has been claimed to be an important dynamic capability for entrepreneurial firms as a learning routine to help them collect outside information to configure their operational processes and resources. This study analyzes the impact of hypothesis testing around the construction of a business model for a new venture. It concludes that hypothesis testing is a driver for venture success, but that there is not a simple relationship between the two. The validation of a greater number of hypotheses does not generate a commensurate increase in the likelihood of venture success. Furthermore, not all aspects of a nascent venture’s business model are equally important for hypothesis testing. Its most significant utility towards venture success lies in the validation of hypotheses around the customer segments, value proposition, and channel.

Implications

Validating all aspects of a business model is not necessarily a useful routine for founders to pursue. Therefore, one contribution of this research is to highlight the existence of boundary conditions around this dynamic capability. The generic emphasis on business model validation, therefore, is misplaced. The attention spent on hypothesis testing for several elements of the Business Model Canvas is at best irrelevant and at worst a significant distraction that undermines eventual venture performance.

This conclusion aligns with the claim that dynamic capabilities are situationally specific and causally ambiguous (Eisenhardt & Martin, 2000), which undermines the operational utility of the theory.
Limitations

The findings of this study are constrained by a few limitations. First, the analysis relied on natural variation between treatments; the sample was not subjected to a controlled experiment. The most visible manifestation of this methodological limitation is in the distinction of “active users”. There is no empirical way within this dataset to determine if “active” entrepreneurial teams used the online tool to record all data, or if “inactive” teams used a different tool with a similar framework.

A second limitation relates to the dependent variable. Success in a business pitch competition as determined by a panel of judges is not a perfect predictor for subsequent success with investors and customers. Indeed, it may be collinear with validation and the Business Model Canvas as judges may be expecting to hear specific references to these outcomes and elements in their assessment of the venture’s commercial potential.

Moreover, the team may have other success metrics beyond winning the competition. For example, a team that validates hypotheses around Partnerships might secure such a partnership, even if it loses the competition. Therefore, validation of hypotheses for the entire business model and for each individual element might have alternative goals and measures of performance.

The final limitation relates to interpretation. Declaring that an entrepreneurial team is actively engaged in hypothesis testing based on performance for a dichotomous variable is basing much weight on what might be a single event.

Future Research

Additional research may address these limitations. First, a controlled experiment where some teams used one online tool (and the processes and frameworks that it
contains) and some teams used another would provide a comparison to highlight the
drivers of venture success. Such an experiment could explore alternative definitions of a
business model and multiple sequences for its construction.

Second, qualitative investigation into the specific activities of the teams within the
sample would yield insights into the prominence of hypothesis testing to determine if this
routine was in fact important to the venture’s refinement of its business model and its
success in the competition.

Third, a longitudinal study to track the eventual commercial success of these ventures
would provide a more powerful variable for the dependent variable in this model.

The goal of such research would be the creation of a framework as a subset of or
alternative definition to a business model where each element has a demonstrable positive
impact on eventual venture success. The result of these studies would be a consistently
useful tool in applying the entrepreneurial dynamic capability of hypothesis testing for
new ventures in fast moving environments.
APPENDIX B: HOW CUSTOMER INTERACTION AND EXPERIMENTATION ADVANCE NEW VENTURE CONCEPTS IN A CLEANTECH ACCELERATOR

ABSTRACT

Entrepreneurs often conduct experiments and interactions with potential customers to advance early concepts for a business venture to improve its likelihood of commercial success. Both approaches figure prominently in the currently popular Lean Startup Method, which has been designed as a deliberate process to overcome the founders’ confirmation bias. We empirically analyze survey and performance data of 248 teams in an annual accelerator program where entrepreneurs apply technologies to global social and environmental problems. We find that customer interaction conducted by itself increases venture performance, perhaps by improving the selection criteria for modifying the initial concept beyond the founders’ biases. On the other hand, experimentation alone has no significant direct effect on venture performance. When these two activities are conducted together, venture performance shows diminished improvement; experimentation dampens the positive impact of customer interaction. Instead of complementarity between these two activities as predicted by the Lean Startup Method, we find evidence that they are substitutes. It is possible that the solicitation and incorporation of customer feedback through both of these activities exhibits an inverted U effect where too many interactions distract entrepreneurs from more fruitful activities. This conclusion questions the efficacy of concurrently employing multiple Lean activities. Additional research is invited to develop more reliable scales of customer interaction and experimentation and to specify conditions and the mechanisms by which they impact business start-up performance.
INTRODUCTION

Within the past fifteen years researchers have broadened their investigations beyond what entrepreneurs create to the processes by which they create (Alvarez & Barney, 2007). Although there are several ways to design and validate a business idea prior its launch, Mintzberg and Waters (1985) identify two extremes. In a deliberate approach, the outcomes match the leaders’ intentions: the idea that emanates from the conceptualization process is identical to what was initially predicted. There are several benefits to such a deliberate strategy: a signaling of focus and commitment to key stakeholders including partners and investors, as well as the accumulation of learning effects and first mover advantages (Andries, Debackere, & Looy, 2013). The deliberate method, characterized by a formal business plan constructed from secondary sources, has been indeed shown to improve venture performance when compared to the absence of any such plan (Shane & Delmar, 2004).

At the other extreme, emergent processes generate results that unexpectedly diverge from the intended plan. At its extreme, there might be neither plan nor process; the business idea crystallizes through a series of accidents and coincidences. In between these extremes are “deliberately emergent” approaches (Mintzberg & Waters, 1985, p. 263) where the process is fixed but the outcomes are assumed to be unknown and expected to emerge en route. Deliberately emergent processes are explicitly designed to collect and incorporate new information from the marketplace into the initial business idea to improve its likelihood of success. The new information typically changes the business idea – sometimes radically – from what the founders initially conceived (McGrath & MacMillan, 1995).
Do emergent changes to the business concept increase the commercial potential of the venture? Evolutionary theory (Darwin, 1859) posits that under conditions of scarcity, a few variations are selected to improve the fitness of the entity. While new ideas are often abundant, the resources required by an entrepreneur to develop and launch an idea into the marketplace are scarce. Indeed, variation and selection can result in fitter ideas when they are filtered through useful selection criteria.

Typically, the founders’ initial cognitive frame is not a useful filter for selecting between competing ideas. Entrepreneurs are generally highly optimistic (Hmieleski & Baron, 2009). While this prompts them to start their own ventures despite obvious challenges (Lowe & Ziedonis, 2006), it also produces overconfidence in the venture concept (Busenitz & Barney, 1997; Hayward, Shepherd, & Griffin, 2006), spawning confirmation bias that manifests in the rejection of any information that contradicts the entrepreneurs’ preconceptions about the venture’s commercial promise (R. A. Baron, 2004; Parker, 2006). Introducing process-based selection using external criteria may therefore overcome confirmation bias.

The recently popularized Lean Startup Method (Ries, 2011) can be viewed as a unique example of a deliberately emergent approach. Proponents of the Lean approach contend early and frequent feedback from potential customers generate rapid improvements in the business model, improving the likelihood of venture success (Blank, 2013). Such feedback may replace the internal selection criteria from the founders’ confirmation biases. The Lean approach stands in stark contrast to the traditional, deliberate method of formulating a business plan using secondary market research but no direct customer feedback as the sole source of information for refining a venture concept prior to launch.
As yet, there are no empirical studies that compare the efficacy of the traditional deliberate approach to a deliberately emergent approach in generating successful ventures. This research paper seeks to fill this gap by exploring whether certain Lean processes for conceptualization influence the success of the resulting venture: do customer interactions and experimentation produce more successful businesses?

To assess the efficacy of such activities we use ten year panel data from a cleantech accelerator program where several hundred teams each year received three months of intensive coaching to construct new business ideas that address global social and environmental problems, such as climate from carbon-intensive energy sources or limited access to potable water, through the application of “clean” technologies. Some teams followed a deliberately emergent process to solicit customer feedback through interactions and experiments, whereas others did not. At the end of the program, each team pitched their venture concept to a panel of judges, which awarded substantial prizes to the winners to support their commercial launch. Our study employs datasets from participant surveys about the activities they conducted, as well as competition results supplied by the accelerator program.

This environment is appropriate for testing hypotheses around the impact of these activities for several reasons. First, all teams within a given year are subject to similar external trends because they are all within the same narrow market niche. They are judged by identical performance measurements, where the panels of experts adjudicating the pitch competitions use standardized rubrics. Furthermore, they are all at a similar stage of development: they have all developed an initial idea for the accelerator’s application process, but have not yet garnered substantial investment or customer
revenue. With all of these similarities, we can better isolate the specific impacts of these activities on venture performance.

Second, the studied market is growing rapidly, with US$6.4 trillion estimated to be invested in the sector over the next decade, of which US$1.6 trillion is expected to be directed toward small businesses operating in developing countries (WorldBank, 2014). Verifying and refining drivers of success for these small businesses may have a substantial economic impact to investors, customers, regional economies, and the entrepreneurs themselves.

Third, cleantech entrepreneurs address major social and environmental problems – typically for economically disadvantaged people at the bottom of the pyramid. For example, many ventures apply novel technologies and business models to generate low-carbon electricity or uncontaminated water for perpetually impoverished communities. These entrepreneurs may explicitly opt for slower growth or lower profits in order to serve these segments. The optimism required for pursuit of such social enterprises may increase the founders’ biases; their altruistic attachment to improving the greater good may blind them to information that suggests that their specific approach is not viable. If Lean methods can overcome elevated bias within this environment, such methods might offer even greater gains to ventures in other sectors with less propensity for founders bias.

The remainder of the paper is organized as follows. We first examine the extant literature on experimentation and customer interaction, especially as proposed in the Lean Startup Method, to derive testable hypotheses. We then describe the study sample and method for collecting and analyzing our data, followed by a report of our results and a
discussion on their implications. We conclude by detailing the limitations of the research and suggestions for further study.

THEORY AND HYPOTHESES

Emergence and Bias

The distinction between deliberate and emergent strategies (Mintzberg & Waters, 1985) rests upon the gap between initial intentions and venture outcomes. The “emergentness” (Mintzberg & Waters, 1985, p. 258) of a strategy is the degree to which the outcomes diverge from the initial assumptions. A deliberately emergent strategy such as the Lean Startup Method seeks to intentionally generate unexpected outcomes, and is therefore expected to evolve the business concept between the start and the termination of the conceptualization process.

A central unanswered question from Mintzberg and Water’s paper is the relative added value of this emergentness. Do the changes to a new venture concept that materialize from a deliberately emergent process increase the likelihood that the resulting business will perform better?

Several theories suggest that the entrepreneur’s initial concept is rarely ideal. The entrepreneur does not hold all pertinent information at the beginning of the conceptualization process (Hayek, 1945). Even with limited knowledge, the entrepreneur’s decision-making is bounded by prior experience and cognitive limitations (Simon, 1972). Primary among these limitations is cognitive bias (Nickerson, 1998), whereby the founders become attached to information that supports the potential market success of their new venture and reject any information that refutes its potential (Dane, 2010; Klayman & Ha, 1987). As a result, they become overconfident in their chosen
concept (Busenitz & Barney, 1997) and pursue a venture that does not generate profit. A process that forces the founders to seek external information is likely to overcome this bias and prompt changes to the business concept. When this external information reflects the pressures of the marketplace and is used to create criteria for selecting new ideas and modifications, the outcome is likely to have improved fitness (Spencer, 1887), echoing the mechanism of natural selection that underlies biological evolution (Darwin, 1859).

**The Lean Startup Method**

The Lean Startup Method is a triumvirate of processes that are typically followed sequentially and recursively. First, the entrepreneurial team generates a simple graphical *business model* (Maurya, 2012; Osterwalder & Pigneur, 2010) that contains key hypotheses about customer and other key stakeholder behaviors. Second, the entrepreneur tests these hypotheses through low cost *interactions with potential customers* (Blank & Dorf, 2012). Rejected hypotheses are constantly replaced with new hypotheses through revisions in the initial business model and then re-tested. Finally, surviving hypotheses are tested with stricter *experiments* where specifically selected options require direct customer tradeoffs (Ries, 2011).

In this research, we explore the drivers of business success. An entrepreneur may employ both customer interaction and experimentation (Figure B1) without explicitly focusing on particular definitions of the firm’s business model. Hence, this research does not test the first step of the Lean method but instead analyzes the effects of the second and third steps – customer interactions and experimentation – on venture performance.
Customer Interaction

The second step in the Lean method advocates open-ended interviews with potential customers (Blank & Dorf, 2012; Maurya, 2012) to create, confirm, reject, and alter hypotheses within the business model in a process called Customer Discovery (Blank, 2006). These customer interactions combine the demonstrated importance of incorporating customer reactions into product design (Kotler, 2011) with the data-driven decision-making of evidence-based management (Rousseau, 2006). More specifically, customer opinions have been shown to create and improve innovation (H. W. Chesbrough, 2003; Von Hippel, 2005) through the entrepreneurs’ experiential learning (Corbett, 2005; Kolb, 1984).

Importantly, when deciding which changes to retain, entrepreneurs employing customer interactions rely on selection criteria that emanate from opinions of external customers (Blank, 2006) to overcome the founders’ “inside-out” (McGrath, 2010, p. 248) confirmation bias.

*Hypothesis 1: Entrepreneurial teams that interact with more potential customers during the construction of their venture concept perform better than teams with fewer interactions.*

The null hypothesis states that customer interactions have no impact on the team’s success. This might be caused by several different factors. First, the founding team’s
confirmation bias might extend to its selection of customers with whom to interact, thus reducing the objectivity of customer opinions. Second, the team may have inadequate sample size of customer interactions, generating haphazard ungrounded changes in the concept. Third, the team may follow the deliberate process of soliciting customer opinions, but reject or omit the emergent information, where the bias is more powerful than the process.

**Experimentation**

The third component of the Lean approach introduces the notion of using prototypes as experiments – often called minimum viable products (Ries, 2011) – to acquire new knowledge (Huber, 1991), validate early market demand, verify technical capabilities, and explore low-cost alterations (Chandler et al., 2011). Whereas customer interactions are typically open-ended responses to open-ended questions, experiments force customers to actively make decisions and find trade-offs, helping to better predict their behavior. Experimentation borrows from agile product development and lean manufacturing popularized by the Toyota production system (Ōno, 1988). The “centrality of experimentation” (Ōno, 1988, p. 253) is especially vital in fast-moving industries where the dominant paradigms shift frequently (McGrath, 2010) and where disruptive innovation is prevalent (Christensen, 2003).

Experiments generate knowledge through indirect observation (Holcomb, Ireland, Holmes Jr, & Hitt, 2009) and improve the business idea by iterative revisions (Thomke, 2003). They prompt the entrepreneur to consider new recombinations of ideas during the construction and execution of the experiment through bricolage (Baker & Nelson, 2005; Lévi-Strauss, 1966). Moreover experiments with potential customers force the founders
to seek external selection criteria and reduce the impact of their confirmation bias. We postulate that experimentation increases the likelihood of the venture’s success.

**Hypothesis 2:** *Entrepreneurial teams that run several experiments when they construct their venture concept perform better than teams that conduct no or few experiments.*

The null hypothesis states that experimentation has no impact on venture success. In addition to the justifications given for the null hypothesis around customer interaction, experimentation may fail to improve venture success if the entrepreneurs construct experiments that ask the potential customers to select from among options that are all within the entrepreneurs’ bias. These experiments might locate a local optimum among the limited options, but may fail to discern global optima.

*Combination of Customer Interaction and Experimentation*

The hypotheses above consider these two activities independently. What happens when they occur together during the same conceptualization process? Confirmation bias is not banished in a single victory; it continues to invade even a deliberately emergent process at every opportunity. A process with multiple steps, each designed to overcome bias, may remind the founders repeatedly to embrace outside selection criteria throughout each step. It is also possible that customer interaction provides coarse adjustment, helping the founders make major leaps to new ideas, whereas experimentation adds fine-tuning to achieve a proximate local optimum. We assert that these two activities positively reinforce each other as complements, contributing more together to the success of a venture than would be explained by the sum of the impact of the activities independently.
**Hypothesis 3:** Entrepreneurial teams that engage in both customer interaction and experimentation generate venture concepts that perform better than could be explained by the simple sum of the impacts of these activities.

The null hypothesis declares that the combination of these activities does not generate more success than would be explained by the sum of the effects of each activity independently. This would be explained by the possibility that customer interaction and experimentation generate different information through unrelated mechanisms, and are thus not complementary to each other.

**METHOD**

In this section, we describe our research design by describing our sample and operationalization of the measures to validate the hypotheses. We also document the process of refining the survey instrument and collecting the data. We then discuss response rate and factor analysis to create a measurement model.

**Research Design**

Testing these hypotheses first requires data on the actual activities performed by a venture team as it refine its venture concept prior to the launch of its business. This could be provided by either minute observation or survey. Second, it requires an environment where several exogenous variables can be eliminated or controlled. Collecting data from a large variety of founding teams across different sectors, geographies, and levels of entrepreneur and market maturities might confound an analysis. Instead, a narrower environment allows the analysis to focus on the variables of interest. Third, it requires a similar metric for venture success.
To address these requirements, we sought data from an accelerator program focused on a narrow industry sector. Accelerator programs provide concentrated coaching to teams of entrepreneurs who are developing but who have not yet launched a business venture. In order to efficiently collect data across hundreds teams, we opted to rely on survey data instead of direct observation. Moreover, we sought an accelerator program with a definitive measure of venture success for its participating teams prior to their graduation from the program to reduce the confounding influences of post-graduation activities and events.

**Sample**

The accelerator program we examine in this research was founded in 2005 to promote entrepreneurial startups that commercialize technologies to generate clean energy and clean water (“cleantech”), often for consumers at the base of the world’s economic pyramid. The cleantech accelerator program has grown steadily each year, now boasting over 3,500 alumni around the world who have cumulatively raised over $1 billion in investment through 2014 to support the launch and growth of their ventures. At the conclusion of each year’s program, teams compete by pitching their venture concepts to a panel of judges. The top three teams within several categories of each regional competition progress to an annual global competition, where the top three ventures in each category receive substantial prizes to launch their ventures. As the program gained in popularity, the program increased to eight regions within the U.S. Starting in 2013, the accelerator program encouraged non-Americans to apply and compete within separate overseas regions, but these numbers remain low.
This sample is well suited to test our hypotheses for several reasons. First, all teams are subjected to similar conditions and expectations for the presentation of their business pitches during the competition. Because the judges use the same rubric (included Appendix A) across regions within each year’s program, the success within the business pitch competition is a relatively reliable measure.

Second, teams within the accelerator program are all within the same well-defined industrial sector: technologies aimed at generating clean energy or clean water. As a result, they are subject to similar external market trends.

Third, these teams are all at a similar stage of venture development. They have already developed an initial concept, which is elucidated and evaluated as part of the application process (also included in Appendix A). Furthermore, as required in the application process, they have not generated substantial revenue from these concepts. As a result, they are all nascent startups. None is a division of an existing corporation.

Fourth, the entrepreneurs within these teams have similar ambitions. Because the three-month program is time consuming, these entrepreneurs are not pursuing this idea on a whim. Nor are they students engaged in an academic exercise. Instead, they typically desire to refine the idea, win the competition, and use the prize money and notoriety to launch their ventures.

Fifth, although the accelerator program has provided instructions on how to follow a Lean method via video since 2012, the program does not rigidly require adherence to a prescribed process; teams can follow any approach they desire. This creates variation within our dataset with regard to these approaches.
Finally, cleantech ventures often have a broader mission beyond technology commercialization. For example, many teams focus on low-carbon energy generation because they desire to reduce the causes of climate change. The participants of this accelerator program exhibit attributes of both technology entrepreneurs seeking market profitability through competitive advantage and social entrepreneurs hoping to improve social and environmental conditions, especially for the world’s least privileged populations. This emphasis of mission may increase the founders’ confirmation bias; they are toiling for the greater good. If our hypotheses prove significant with this sample, we are more confident that they can be generalized to more areas of entrepreneurial endeavor.

Unit of Analysis

This paper focuses on the venture concept as constructed and presented by a team of entrepreneurs. For efficiency, we solicited survey data electronically from all of the members of each team. Some team members recalled those activities differently, or attached different significance to those activities. To reconcile any differences, we averaged the responses across all respondents in a team to create a single set of values for each team for each variable.

Measures

Performance – Dependent Variable

The dependent variable for this study is a dichotomous scale that signifies the success in the annual regional pitch competition. The top three pitches within each region within each category win an award and are invited to participate in the national competition. This variable is binary: 0 if they participated in the accelerator program but did not win
an award and 1 if they won a regional award. The performance results were accessed
directly from the accelerator program’s archives; we did not rely on survey results for this
measure.

Although there is little peer-reviewed research on the influence of business pitch
competitions on the financial performance of new ventures after their launch, Russell,
Atchison, and Brooks (2008) found that success in competitions increase participants’
entrepreneurial skills and entrepreneurial self-confidence, which reasonably should lead
on average to better venture performance when compared to those teams that did not
perform well in the competition.

Customer Interaction – Independent Variable

For this variable, we asked respondents to mark their degree of agreement on a 5-point
Likert scale with the following two questions: “We did not talk with customers until the
product/service was almost perfect” (Ci1), and “We relied on market research studies to
define the venture concept” (Ci2). In addition, we asked the respondent to define the
number of customer interviews that the team conducted during the duration of the
accelerator program (Ci3). By departing from the Likert scale for this item, we hoped to
reduce the potential for common method bias. Moreover, the first two questions were
framed in a way that favored is the reverse of the third in an attempt to avoid any bias
towards social desirability or acquiescence (Podsakoff, MacKenzie, Lee, & Podsakoff,
2003; Weijters & Baumgartner, 2012).
Experimentation – Independent Variable

To assess the team’s engagement in experiments we asked three questions using a 5-point Likert scale: “We created at least one minimum viable product” (Xp1), “We designed several experiments to test the assumptions of the concept” (Xp2), and “We did not construct any prototypes” (Xp3). The last item was oppositely worded compared to the first two, again to reduce the effects of acquiescence.

Controls

We included items to control for amount of education (measured as degrees earned, from high school to doctorate) per Zhao, Seibert, and Hills (2005), age (measured as birth year and then calculated to ascertain the respondent’s age in years at the time of the competition) per Cabral and Mata (2003), and gender per Wilson, Kickul, and Marlino (2007), Bae, Qian, Miao, and Fiet (2014), and Zhao et al. (2005).

Pre-test

Prior to finalizing the measures for our survey, several entrepreneurs and entrepreneurship educators verbally described their reactions to each question in a “talk aloud” exercise (Bolton, 1993). Ten colleagues then sorted the questions into general categories that aligned with our primary constructs called a “q-sort” (Block, 1961). Thirty MBA students studying social entrepreneurship completed the resulting survey. (None of these pre-test respondents were in our intended sample audience.) Through these exercises, we eliminated several ambiguous words to refine our constructs. These exercises also prompted us to add Ci3 about the number of customer interviews.

We used both online and paper formats. For the online form, every respondent received a newly randomized order of questions. For the paper form, the order of the
questions was randomized prior to printing, and then all respondents received the same order. Prior to analysis, oppositely worded items were reverse coded. The data from the surveys were matched with the data indicating the success of the team within the accelerator program’s pitch competition.

**Data Collection**

We sent the survey to all 3,552 alumni of the accelerator program between 2005 and 2014 in four different tranches. These alumni belonged to 1,649 teams, thus averaging 2.2 people per team. We first sent an email survey in August 2014 to the 2,700 people who had applied for admission into the accelerator from 2005 to 2013. We also sent two follow-up email reminders one and two weeks after the initial distribution. We then sent a paper version of the survey via U.S. mail to the 700 people who applied to the program in 2012 or 2013, but who had not replied to the email survey or for whom we did not have an email address. We also sent a postcard to the 600 leaders of the teams who participated in the program from 2005 to 2011 asking them to complete the email survey. Finally, we sent another email survey to the 750 applicants to the 2014 accelerator program within days of its conclusion in November 2014, followed by a reminder email one week later. We did not send a paper survey or postcard to the 2014 program participants.

**Response Rates**

Of the 3,552 alumni of the cleantech accelerator program, 3,337 with email addresses received surveys. Four hundred and forty email addresses were invalid; 2,897 individuals received the email. (We cannot determine how many of these emails were intercepted by spam filters, and thus did not arrive.) A total of 344 individuals responded to the survey
(9.7% of all alumni; 11.9% of those who received the email) with 274 of those responses providing complete data for this analysis (7.7% of all alumni; 9.5% of those who received the email). Fifty-two respondents were on the same team as another respondent. These overlapping responses were averaged for those 26 teams. In conclusion, we collected complete data for 248 teams (15.0% of all teams). Table B1 reports response rates by year. Unsurprisingly, response rate increased for individuals who had participated in the accelerator program more recently. Because only complete responses were selected, no data imputation was conducted.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of individuals</th>
<th>Total number of teams</th>
<th>Individual responses</th>
<th>Complete individual responses</th>
<th>Teams with at least one complete response</th>
<th>Response rate for individuals</th>
<th>Response rate for teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>836</td>
<td>432</td>
<td>142</td>
<td>110</td>
<td>96</td>
<td>13.2%</td>
<td>22.2%</td>
</tr>
<tr>
<td>2013</td>
<td>428</td>
<td>184</td>
<td>72</td>
<td>59</td>
<td>54</td>
<td>13.8%</td>
<td>29.3%</td>
</tr>
<tr>
<td>2012</td>
<td>366</td>
<td>162</td>
<td>48</td>
<td>40</td>
<td>36</td>
<td>10.9%</td>
<td>22.2%</td>
</tr>
<tr>
<td>2011</td>
<td>383</td>
<td>170</td>
<td>27</td>
<td>23</td>
<td>21</td>
<td>6.0%</td>
<td>12.4%</td>
</tr>
<tr>
<td>2010</td>
<td>227</td>
<td>98</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>4.8%</td>
<td>10.2%</td>
</tr>
<tr>
<td>2009</td>
<td>222</td>
<td>84</td>
<td>12</td>
<td>9</td>
<td>9</td>
<td>4.1%</td>
<td>10.7%</td>
</tr>
<tr>
<td>2008</td>
<td>323</td>
<td>150</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>2.8%</td>
<td>6.0%</td>
</tr>
<tr>
<td>2007</td>
<td>328</td>
<td>154</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>3.0%</td>
<td>6.5%</td>
</tr>
<tr>
<td>2006</td>
<td>384</td>
<td>168</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>0.8%</td>
<td>1.8%</td>
</tr>
<tr>
<td>2005</td>
<td>55</td>
<td>47</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Totals</td>
<td>3552</td>
<td>1649</td>
<td>344</td>
<td>274</td>
<td>248</td>
<td>7.7%</td>
<td>15.0%</td>
</tr>
</tbody>
</table>

The average age of the respondents at the time that they participated in the accelerator program was 45 years. Eighty-six percent of the respondents were male with an average of at least a master’s degree. (Because these demographic variables are used as controls, further details are included with the other independent variables in Table B5.)
Response Bias

Of the data for these 248 teams, 226 emanated from email surveys, 19 from paper surveys, and 3 from a mix of both (for teams with multiple respondents). These latter two categories are too small to conduct any statistical tests to determine response bias by method.

To assess non-response bias, we compared the responses submitted immediately after the initial email was sent to responses that were received after a reminder. The Chi Square difference test between the two models shows nonsignificant difference (p<.574), suggesting that initial responders were not statistically different than late responders, reducing the threat of non-response bias.

Measurement Model

Means, standard deviations, kurtosis and correlations for the six items that were included in our two factors are displayed in Table B2. (Because our dependent variable – the venture’s success in the business plan competition – emanates from a separate dataset without any respondent input, it was not included in the factor analyses.) Ci3 asked the respondent to declare the number of customer interactions during the course of the accelerator program. Due to a mistake in survey construction, the values for this variable were bounded at 100. It turned out that many respondents selected this upper bounded value such that we could not use the absolute scale (or its log transformation) as a variable directly. To alleviate this constraint, the responses were grouped into five quintiles with an equal number of respondents in each group. The structure of the transformed variable is similar to the raw variable (Figure B2).
Table B2: Item Details and Correlations

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>S.D.</th>
<th>Kurtosis</th>
<th>Critical Ratio</th>
<th>Ci1^</th>
<th>Ci2^</th>
<th>Ci3#</th>
<th>Xp1</th>
<th>Xp2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ci1^</td>
<td>4.24</td>
<td>1.06</td>
<td>0.98</td>
<td>3.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ci2^</td>
<td>3.37</td>
<td>1.25</td>
<td>-1.16</td>
<td>-3.74</td>
<td>.148*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ci3#</td>
<td>2.00</td>
<td>1.40</td>
<td>-0.10</td>
<td>-0.31</td>
<td>.184**</td>
<td>.161*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xp1</td>
<td>4.07</td>
<td>1.21</td>
<td>0.49</td>
<td>1.57</td>
<td>-0.024</td>
<td>0.093</td>
<td>.211**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xp2</td>
<td>3.71</td>
<td>1.24</td>
<td>-0.47</td>
<td>-1.50</td>
<td>-0.008</td>
<td>-0.054</td>
<td>0.073</td>
<td>.213**</td>
<td></td>
</tr>
<tr>
<td>Xp3^</td>
<td>4.18</td>
<td>1.26</td>
<td>0.62</td>
<td>1.98</td>
<td>0.074</td>
<td>.126*</td>
<td>.150*</td>
<td>.389**</td>
<td>.348**</td>
</tr>
</tbody>
</table>

* p<.05 (2-tailed), ** p<.01 (2-tailed), ^ reverse coded before analysis, #transformed

Figure B2: Ci3 Variable Transformation

The result of an exploratory factor analysis suggested a model with two factors, each with three items, explaining 23% of the variance. With no loadings less than .350, the pattern matrix (Table B3) supports convergent validity of the three items on each of the two factors. Moreover, with no cross-loadings greater than .2 as befits a sample size of 248, this pattern matrix provides evidence of discriminant validity between the factors (Hair, Black, Babin, & Anderson, 2013).
Table B3: Exploratory Factor Loadings

<table>
<thead>
<tr>
<th></th>
<th>Experimentation</th>
<th>Customer Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ci1</td>
<td>0.403</td>
<td></td>
</tr>
<tr>
<td>Ci2</td>
<td>0.415</td>
<td></td>
</tr>
<tr>
<td>Ci3</td>
<td>0.424</td>
<td></td>
</tr>
<tr>
<td>Xp1</td>
<td>0.505</td>
<td></td>
</tr>
<tr>
<td>Xp2</td>
<td>0.525</td>
<td></td>
</tr>
<tr>
<td>Xp3</td>
<td>0.707</td>
<td></td>
</tr>
<tr>
<td>Eigenvalues</td>
<td>1.78</td>
<td>1.25</td>
</tr>
<tr>
<td>Variance Explained</td>
<td>18.95</td>
<td>7.40</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
Rotation converged in 3 iterations.

However, with composite reliability (Table B4) and Cronbach Alpha values (along the diagonal in Table B5 for the two composite latent variables) lower than the ideal .7 and .6 thresholds respectively, the reliability of these factors remains somewhat questionable. Moreover, average variance extracted (AVE, Table B4) for each construct is less than the ideal threshold of .5, undermining perfect convergent validity. Because AVE is greater than either maximum shared variance or average shared variance, we found adequate support for discriminant validity in each of our two independent variables (Hair et al., 2013).

Table B4: Construct Reliability and Validity

<table>
<thead>
<tr>
<th></th>
<th>Composite Reliability</th>
<th>Average Variance Explained</th>
<th>Maximum Shared Variance</th>
<th>Average Shared Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Interaction</td>
<td>0.372</td>
<td>0.176</td>
<td>0.138</td>
<td>0.078</td>
</tr>
<tr>
<td>Experimentation</td>
<td>0.602</td>
<td>0.348</td>
<td>0.138</td>
<td>0.082</td>
</tr>
</tbody>
</table>

These low values may be attributed to the paucity of items for each construct and the low variance within several items as reflected in a Kaiser-Meyer-Olkin measure of sampling at .603, which is below the ideal threshold of .8 (Hair et al., 2013).
A confirmatory factor analysis of this measurement model using maximum likelihood in AMOS (v22) shows good model fit (Chi^2=12.52, df=8, CFI=.955, RMSEA=.048, PCLOSE=.470) (Byrne, 2013; Hair et al., 2013), demonstrating that the two constructs adequately account for the data when no cross-loading is considered.

The dependent variable in our study is the dichotomous categorical variable signifying the success of the venture team in winning an award in the regional competition. To allow for more analytical flexibility, we elected to also interpret this variable as the probability of winning an award. Its mean value of .34 can be interpreted as 34% of teams participating in the accelerator program won an award within their regional competition, and that a new entrant has a 34% chance of winning an award in their regional competition.

This binary variable is non-normally distributed, with a critical ratio (z-score) of kurtosis of -5.09, just above the threshold of |5.0| that is necessary for covariance analysis of the structural equation model with a tool like AMOS (Byrne, 2013). Thus, the
subsequent analysis employs binary logistic regression, which does not require normality of the dependent variable.

**RESULTS**

In a binary logistic regression model with our two independent variables, the interaction term (formed by the multiplication of the standardized independent variables), and two controls, the omnibus test of model coefficients reports that the model shows good fit (Chi^2=22.3, df=5, p<.001 where a significant p-value connotes good model fit). This is echoed in the Hosmer and Lemeshow test (Chi^2=5.299, df=8, p<.725 where an insignificant p-value connotes good model fit) (Hosmer Jr & Lemeshow, 2004). The model’s Nagelkerke pseudo-R^2 reports that the model explains 11.9% of the variance. The Wald test (Harrell, 2001) (Table B6) concludes that experimentation is nonsignificant, customer interaction is significant and positively related to venture success, and the interaction term is significant and negative. In addition, of the two controls, Highest Education is nonsignificant but Age is significant and negatively related to venture performance, where younger participants produce ventures that perform better.

**Table B6: Results of Binary Logistic Regression with Controls and Interaction**

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
<th>90% C.I.for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Customer Interaction</td>
<td>0.416</td>
<td>0.185</td>
<td>5.065</td>
<td>1</td>
<td>0.024</td>
<td>1.516</td>
<td>1.119</td>
</tr>
<tr>
<td>Experimentation</td>
<td>0.072</td>
<td>0.186</td>
<td>0.15</td>
<td>1</td>
<td>0.698</td>
<td>1.075</td>
<td>0.792</td>
</tr>
<tr>
<td>Customer Interaction x Experimentation</td>
<td>-0.437</td>
<td>0.196</td>
<td>4.977</td>
<td>1</td>
<td>0.026</td>
<td>0.646</td>
<td>0.468</td>
</tr>
<tr>
<td>Age</td>
<td>-0.027</td>
<td>0.01</td>
<td>6.796</td>
<td>1</td>
<td>0.009</td>
<td>0.973</td>
<td>0.957</td>
</tr>
<tr>
<td>Highest Education</td>
<td>-0.101</td>
<td>0.098</td>
<td>1.046</td>
<td>1</td>
<td>0.306</td>
<td>0.904</td>
<td>0.769</td>
</tr>
<tr>
<td>Constant</td>
<td>1.022</td>
<td>0.568</td>
<td>3.237</td>
<td>1</td>
<td>0.072</td>
<td>2.778</td>
<td></td>
</tr>
</tbody>
</table>
In conclusion (Table B7), Hypothesis 1 is supported, where customer interaction shows a significant positive relationship with success as predicted. Hypothesis 2 is rejected because experimentation shows no significant relationship to venture success. Hypothesis 3 is also rejected because the combination of customer interaction and experimentation generates a significant but negative relationship to venture success.

**Table B7: Summary of Findings**

<table>
<thead>
<tr>
<th>#</th>
<th>Hypothesis</th>
<th>Conclusion</th>
<th>Significant?</th>
<th>Observed Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Customer Interaction (+) -&gt; Venture Success</td>
<td>Supported</td>
<td>Yes</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Experimentation (+) -&gt; Venture Success</td>
<td>Rejected</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>CI x E (++) -&gt; Venture Success</td>
<td>Rejected</td>
<td>Yes</td>
<td>-</td>
</tr>
</tbody>
</table>

**DISCUSSION**

This study suggests that an entrepreneurial team’s incorporation of external information from customer interactions increases the likelihood of the venture’s success. The improved success from customer interaction may be caused by the replacement of the founders’ confirmation bias with external criteria from customers, helping the founders select modifications to the venture concept that improve its chance for success.

We find no relationship between venture performance and experimentation when the activity is conducted by itself, absent any customer interaction. It is possible that while the execution of an experiment also collects external information, its value is diminished because the entrepreneurs’ biases were already manifested during the design of the experiment. Alternatively, experimentation without customer interaction may only select between a handful of the founders’ already emotionally favored options. Thus experimentation by itself seems to be an irrelevant activity.
This study also finds that teams that employ both customer interaction and experimentation to refine their concept actually perform worse than those teams who only relied on customer interaction alone because experimentation dampens the effect of customer interaction on success (Figure B3). In short, these findings suggest that these two activities are not complementary as predicted, but may instead be substitutive (Figure B4). For a given level of venture success, an increase in one activity requires a decline in the other.

**Figure B3: Interpretation of Interaction**

![Figure B3](image)

**Figure B4: Possible Frontier for Venture Success**

![Figure B4](image)
What might explain this relationship? First, these two activities might generate the same redundant conclusions such that the second activity is wasted effort distracting from more fruitful activities. Second, the activities might generate different information, but the combination might overload the team, causing too many changes that become disruptive to the team’s focus. The solicitation and consideration of customer-related feedback from both customer interaction and experimentation may exhibit diminishing and then declining returns, forming an inverted U (Figure B5). This might be caused by cognitive overload, where too many types of feedback overwhelm the founders’ ability to receive, contemplate, and then incorporate customer-generated ideas into the selection criteria above a certain threshold, a phenomenon that has explained other surprising interaction effects among entrepreneurs (Hmieleski & Corbett, 2008).

**Figure B5: Impact of Customer Feedback on Venture Success**

This dampening phenomenon may be particularly pronounced within the cleantech sector for several reasons. First, some break-through innovations, especially those involving hardware as opposed to software (Maurya, 2012), may resist experimentation because they are all-or-nothing products where slight modifications are not feasible. Alternatively, conducting nuanced experiments with customers in remote regions of
developing nations – the intended geographies for many cleantech ventures – may be more difficult than interacting with customers for open-ended conversations. Yet another explanation may rest on the heightened optimism found in cleantech entrepreneurs. Too much feedback from customers through both customer interaction and experimentation may not only conquer the founders’ confirmation bias but also erode their self-confidence, causing them to question their own entrepreneurial abilities and sense of self-efficacy, reducing their enthusiasm for the venture.

This dampening effect may also be prominent in a business pitch competition, where experts judges can assess the coarse ideas of the venture concept that emanate from customer interaction, but cannot discern the subtle refinements that experimentation might engender, and that might only appear from a large number of customer purchase decisions when the venture is launched.

Finally, regarding the controls, we find that education has no significant impact on venture success but age is negatively associated with success such that younger founders perform better. This may also support our contention that confirmation bias undermines success, because younger entrepreneurs have been found to suffer less from cognitive entrenchment (Parker, 2006).

CONCLUSION

Contemporary pedagogy in entrepreneurship emphasizes the importance of customer interaction and experimentation as two steps of the increasing popular Lean Startup Method to improve the performance of a new venture idea. Our research finds that customer interaction increases the likelihood of venture success, perhaps by replacing the founders’ confirmation bias with external criteria by which they can select new ideas and
modifications that will improve venture performance. However, employing these two activities together dampens that increase, perhaps by overloading the founders with new ideas or distracting the entrepreneurs with redundant activities. We also find that experimentation by itself has no significant impact on venture performance.

As one of the first empirical analyses of Lean phenomena, this study has several limitations that warrant additional research, especially in the measurement of these activities. Nonetheless, its conclusions urge entrepreneurs to temper their faith in the efficacy of the Lean Startup Method until it undergoes further research and refinement.

Limitations

This study has several limitations. First, with only three items per construct and kurtotic distributions, the reliability and convergent validity of our constructs are somewhat questionable. It is possible that our constructs do not adequately reflect the phenomena of customer interaction and experimentation. Moreover, our scales might not distinguish between the theoretical distinctions underlying these concepts. With a correlation of .541, these two activities may frequently accompany each other or the respondents may have overlapping definitions where experiments involving potential customers might simultaneously be considered customer interactions. In other words, respondents to our survey may view experimentation as a subset of customer interaction due to insufficient distinction between the definitions. Similarly, this study did not examine the order in which customer interaction and experimentation were conducted. It is possible that, if performed in sequence (CI -> E), these two activities might be found to be complementary, but when performed in reverse or in haphazard order, they might dampen each other, as found in this study.
Second, the dependent variable in our study – success in a business plan competition – has low variance because it is a binary dichotomous variable, lacking the depth and nuance of commercial performance in the market, where there are many metrics and degrees of success. Further, even though this variable for venture success was created by a panel of business experts outside of the opinions of the founders themselves, success in a business plan competition has not yet been strongly associated with commercial profitability in the extant literature. Additionally, as the Lean Startup Method has grown in popularity, some of its concepts are now reflected in the rubric. It is possible that judges are forced by the rubric to measure the team’s adherence to the Lean principles instead of assessing the team’s proposal’s potential for market success.

Third, this study postulates that customer interaction and experimentation are significant drivers of venture success due to their ability to overcome the venture team’s confirmation bias by involving external judgments during the selection of new ideas as the concept evolves. Our study did not test this mechanism – or any other competing theories – directly, but primarily through inference.

Finally, while our sample was chosen in part because cleantech entrepreneurs may exhibit stronger confirmation biases as they address complex social and environmental problems among impoverished communities, it is also possible that the intractability of these problems and the remoteness of the target audiences compounds the difficulties in collecting customer feedback. Entrepreneurs following the Lean Startup Method in more developed markets to tackle more soluble problems may have more success with these activities.
Future Research

These limitations suggest several areas for further exploration. First, the construction of more reliable scales to capture the distinct activities within customer interaction and experimentation would benefit future studies into methods of entrepreneurial pedagogy. These scales should focus both on the activities being performed by the team and the impact of these activities on the venture concept. For example, some interactions or experiments may alter the selection criteria for choosing to retain or neglect new information, whereas others may not. Understanding when new information is sufficient to overcome confirmation bias would be a useful field of inquiry. Such scales might arise from observational or qualitative studies of venture teams in action, and would also highlight the qualitative and quantitative differences between these two activities, as well as the implications for the sequence in which they are performed.

Second, the impact of these phenomena should be correlated to dependent variables that are both more nuanced and more closely associated theoretically and numerically to venture success in the marketplace. Such an emphasis certainly introduces more exogenous factors into the model, but would yield results that could be more reliably extrapolated to long-term venture performance.

Third, future research into the importance of customer interaction and experimentation should endeavor to simultaneously incorporate competing drivers and mechanisms to allow for more than the refutation of popular theories, but also the affirmation of alternatives.
Fourth, future research might compare the findings from a cleantech accelerator with those of other types of accelerators or incubators to determine the generalizability of these findings across industries.

Finally, this research did not explore the implications of using the concept of a simplified business model (Osterwalder, Pigneur, & Tucci, 2005) as the primary vehicle to test a new venture concept. Focus on this concept has been shown to create value (Zott et al., 2011) and differentiation (Morris et al., 2005) for the firm. Within the framework of this study, emphasis on a business model may serve two purposes. It increases number of dimensions of the business as opposed to a venture concept that hinges on a single idea, creating more candidates for variation and thus selection. It also documents assumptions and hypotheses inherent in the concept. Failure to explicitly name these assumptions is “the single greatest problem to beset new business organizations, namely the treatment of assumptions as though they are facts” (McGrath & MacMillan, 1995, p. 2). Thus the use of a business model may also contribute to overcoming confirmation bias. Future research that empirically tests the efficacy of this component of the Lean Startup Method must also contend with developing scales that evaluate the use of the concept without expecting respondents to understand it a priori.
### Criteria for the Application into the Accelerator Program

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Team</strong></td>
<td>Minimum two people; team members must be credible, able to attract additional quality team members; at least one team member must be US resident, citizen, or legal alien; no member of the team is directly affiliated with the operation of the Cleantech Open</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>The technology or service fits within one or more of the six technology categories of the Cleantech Open, is potentially disruptive and/or demonstrates the potential for a sustainable competitive advantage; the product, service or business model has protected or protectable IP</td>
</tr>
<tr>
<td><strong>Market</strong></td>
<td>The potential market size is large enough for sustained business growth, and aligned with the expectations of possible funding sources (if any)</td>
</tr>
<tr>
<td><strong>Basic Due Diligence</strong></td>
<td>The team owns its own IP, or has an exclusive license to the IP or to a key improvement in the IP, or has reasonable expectation of being able to secure such a license; the team believes their IP claims are valid; team members are well-reputed</td>
</tr>
<tr>
<td><strong>Funding</strong></td>
<td>The company has received less than $1M from private third party investors and less than $5M from all other sources of funding (maximum $6M in total)</td>
</tr>
</tbody>
</table>

### Criteria for the Judges during the Business Pitch Competition

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product-Market Fit</strong></td>
<td>How well substantiated by customer interviews is the target Product/Market? How well does the team understand the initial buyers and their buying criteria?</td>
</tr>
<tr>
<td><strong>Product/Technology Validation</strong></td>
<td>Are the technology and the product proven? Has the product been validated by credible third parties?</td>
</tr>
<tr>
<td><strong>Business Model</strong></td>
<td>How clearly understood and articulated is the business model? How credibly has the team assessed the challenge of fitting into the value chain?</td>
</tr>
<tr>
<td><strong>Market(s) and Getting To them</strong></td>
<td>Is the sequence of target markets and the path to them clear and defensible? Does the cumulative size of the target markets represent an attractive opportunity appropriate to the funding strategy?</td>
</tr>
<tr>
<td><strong>Finances &amp; Financing Strategy</strong></td>
<td>How credible are the revenue and cost projections? Does the team understand how much funding they will need and where they will get it, and does their financing strategy make sense?</td>
</tr>
<tr>
<td><strong>Team</strong></td>
<td>Is the current team credible, with relevant skills and appropriate connections for the product and its market(s)? Does the team know their skill gaps to reach 18-month milestones and how they will fill them with the right people, cost-effectively?</td>
</tr>
<tr>
<td><strong>Legal – IP &amp; Corporate</strong></td>
<td>Is the team’s IP their own and defensible? Do they have an IP Strategy? Is their corporate and cap structure free of issues?</td>
</tr>
<tr>
<td><strong>Sustainability</strong></td>
<td>How well does the team describe and quantify the net environmental, economic and social benefits/impacts of their cleantech application? How well does the team describe and quantify the environmental, economic, and social responsibility and impacts of their operations in manufacturing and providing their technology or service?</td>
</tr>
</tbody>
</table>
APPENDIX C: PERSONALITY TRAITS AND IMPROVISATION AS MICROFOUNDATIONS OF AN ENTREPRENEURIAL DYNAMIC CAPABILITY

ABSTRACT

Experimentation is a vital entrepreneurial dynamic capability to refine a venture’s business model prior to a successful launch into a rapidly changing marketplace. This exploratory analysis finds that the team leader’s conscientiousness is a significant microfoundational antecedent of experimentation. However, contrary to other studies, neither other Big Five traits nor the proclivity for improvisation is also a significant. This research contributes to the search for teachable skills and customization by personality type that would amplify entrepreneurial learning routines. It also highlights the need for improved scales that reflect the nuances of experimentation and other forms of customer interaction.

EXECUTIVE SUMMARY

Interacting with customers and conducting experiments are important entrepreneurial dynamic capabilities to sense new information and opportunities in order to refine a venture’s business model. These processes are repeatable learning routines that reconfigure a potential venture’s business model by harnessing customer opinions to increase its chance of survival in a rapidly changing marketplace. This research paper hypothesizes that an entrepreneur’s Big Five personality traits and proclivity for improvisation are significant microfoundational antecedents to these dynamic capabilities. To test these hypotheses, we examine survey responses from 176 leaders (10.7% response rate) of venture teams in an American cleantech accelerator program using structural equation modeling.
The goal for this research is to identify the characteristics that precede and amplify the impact of customer interaction and experimentation. By correlating personality types to these skills and routines, educators might customize the training of practices like improvisation and activities like experimentation and customer interaction for certain types of learners. The result of this effort will not just be a reduction in the failure rate of entrepreneurial ventures but also a renewed focus on training all budding entrepreneurs beyond those with initially promising ideas.

We find that conscientiousness is moderately significant and extroversion is weakly significant as antecedents to experimentation. Neither improvisation nor other personality traits are significantly related to this activity. Because we could find no existing scales to capture the activities of experimentation or customer interview, this research created new scales, which proved problematic. The primary contribution of this study is to begin the search for scales to support the continued exploration of entrepreneurial dynamic capabilities and their microfoundations.

INTRODUCTION

This paper explores the microfoundations of entrepreneurial dynamic capabilities for high tech venturing. A dynamic capability is defined as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments” (Teece et al., 1997, p. 516). Some of these routines focus on sensing new opportunities (Teece, 2012) by collecting new information through deliberate learning mechanisms that build on experiential information in rapidly changing markets (Eisenhardt & Martin, 2000; Zollo & Winter, 2002) to “purposefully create, extend, or modify [the firm’s] resource base” (Helfat et al., 2007, p. 609). The propensity for and
execution of the learning routines associated with dynamic capabilities can often be traced to the non-firm-specific characteristics of the individuals within the ventures (Eisenhardt et al., 2010; Teece, 2007). These “microfoundations” include personality traits and behaviors of the individual conducting the processes.

In the research on entrepreneurship, several studies have focused on the relationships between personality traits and venture performance, neglecting the repeatable processes that generate these outcomes (Klotz, Hmieleski, Bradley, & Busenitz, 2014). In other words, they have connected microfoundations to venture success, bypassing an examination of dynamic capabilities. Similarly, most research on dynamic capabilities has centered on strategy formulation and execution for existing firms, not on pre-launch startup concepts.

This research seeks to fill these gaps by exploring the relationships between microfoundations and the processes that are conducted during the definition and refinement of a potential venture’s business model. In specific, we examine two entrepreneurial dynamic capabilities that have been linked to improved venture performance: interactions with customers and the execution of experiments (Ladd, Lyytinen, & Gemmell, 2015). By understanding the traits and behaviors that precede these activities, we contribute to the research and pedagogy on efficacious techniques for sensing new opportunities. Understanding the antecedents would allow entrepreneurs to focus on those processes that they are best able to perform successfully based on their existing traits and proclivities.

To explore these questions, this research employs structural equation modeling using survey data from 176 leaders of venture teams in an accelerator program that focuses on
low-carbon energy technologies ("cleantech"). The program is a three-month intensive training regime where some founders solicit customer feedback through interactions and experiments, whereas others do not, creating natural variation between approaches.

The remainder of the paper is organized as follows. First, it reviews relevant research around dynamic capabilities and entrepreneurial traits and behaviors to construct testable hypotheses. Next, it describes the methods in this analysis, including the research design, sample and factor analysis. This is followed by a report of the quantitative findings. The paper concludes with a discussion of the implications of these results for practitioners and researchers, as well as the study’s limitations.

**THEORY AND HYPOTHESES**

Entrepreneurial dynamic capabilities are not rigid, formulaic procedures because such rigidity undermines a procedure’s utility in the face of change (Eisenhardt et al., 2010). These routines are based on situation-specific knowledge from iterative experiential experiments of multiple parallel alternatives with immediate feedback (Brown & Eisenhardt, 1997). This assertion inserts the importance of the entrepreneur’s cognition, which exists apart from these activities. These “microfoundations” are not specific to the firm or to the activities around business model refinement. They are incumbent in the entrepreneur (Eisenhardt et al., 2010; Teece, 2007).

The boundaries (Simon, 1972) around cognition are not identical across all entrepreneurs. The heterogeneous distribution of traits within entrepreneurs leads to heterogeneous behaviors, which in turn lead to differential application of dynamic capabilities. The cumulative differences of traits, behaviors, and processes explain some of the variation between intra-industry firm performance (Zott, 2003).
These traits are defined and measured from different perspectives. For example, Cardon, Wincent, Singh, and Drnovsek (2009) examine the differing roles that founders elect to play within their new ventures. Relying on social identity theory (Hogg & Terry, 2000; Tajfel & Turner, 1979), Fauchart and Gruber (2011) analyze the impact of the type of identity that the founder seeks to create within her social structure on the actions that she performs during the creation of a new venture. Baum and Locke (2004) empirically related skills such as tenacity and motivations such as self-efficacy to venture performance.

This paper adopts a more foundational view of traits: the core characteristics of personality that are mostly immutable across time and situation, regardless of role or social structure. In contrast, behaviors may change more rapidly; they can be taught and then coalesce into habits and heuristics. This paper explores both personality traits and the specific pattern of behavior captured in the construct of improvisation as possible microfoundational antecedents to entrepreneurial dynamic capabilities. First, we discuss personality traits.

**Entrepreneurial Personality Traits**

Personality traits have been shown under some conditions to be reliable antecedents to entrepreneurial status (Zhao & Seibert, 2006), entrepreneurial intent (Hmieleski & Corbett, 2006) and entrepreneurial venture success (Ciavarella et al., 2004). All these studies applied the Big Five traits – openness, conscientiousness, extroversion, agreeableness, and neuroticism (OCEAN) – as a set of exhaustive non-overlapping psychometric constructs (Costa & McCrae, 1992; Digman, 1990; Goldberg, 1999; McCrae, 1987). The Big Five traits are measured with a widely used scale that allows...
cross-comparisons to other activities and behaviors. Felin et al. (2012) recommend that future research explore the relationships between the Big Five and dynamic capabilities in order to build bridges between these two research streams to further inform the practice and teaching of entrepreneurship. We now look at each of the Big Five in turn to construct testable hypotheses.

**Openness**

A person who demonstrates a high level of openness to experience (also often labeled as intellect) is curious and creative, demonstrating divergent thinking, whereas a person with a low score in this personality dimension can be seen as conventional with narrow interests (Zhao & Seibert, 2006). Openness is important to the conceptualization and refinement of new venture ideas for two reasons: it improves the entrepreneur’s ability to recognize new opportunities (Ciavarella et al., 2004; Morrison, 1997; Zhao, Seibert, & Lumpkin, 2010) and reflects the entrepreneur’s creativity to create new solutions (R. A. Baron, 2007).

The literature shows mixed impact for openness for entrepreneurship. Entrepreneurs score higher than managers in this trait (Zhao & Seibert, 2006). The relationship between openness and the intention to eventually form a venture has been fund to be both positive (Zhao et al., 2010) and nonsignificant (Hmieleski & Corbett, 2006). One study concluded that ventures run by entrepreneurs who hold this trait perform worse than entrepreneurs without this trait (Ciavarella et al., 2004), yet another study found the opposite (Zhao et al., 2010). (See Table C1 for a summary and citations to the literature.) Yet none of these empirical results speaks directly to the relationship of openness as a personality trait to the specific routines of customer interaction and experimentation. It is possible that the
inclusion of entrepreneurial dynamic capabilities into these studies as a moderating variable would explain this disagreement: the performance of an entrepreneurial venture may depend on both the trait of openness and the practice of a learning routine.

This paper contends that openness creates a predisposition for an entrepreneur to seek and incorporate outside information into her new venture idea. This trait not only prompts an entrepreneur to undertake the processes of customer interaction and experimentation but also to repeatedly employ them.

Hypothesis 1: Participants who demonstrate high scores in Openness engage more in a) Customer Interaction and b) Experimentation.

Conscientiousness

Conscientiousness is defined as a person’s degree of organization and persistence to accomplish goals, reinforced by self-control and a sense of responsibility for others. Low scores in this dimension reflect low motivation and undependability (Zhao & Seibert, 2006; Zhao et al., 2010). A conscientious focus on end-goals improves the likelihood of venture success (Baum & Locke, 2004). It has both been nonsignificant (Hmieleski & Corbett, 2006) and positively related (Zhao et al., 2010) to entrepreneurial intent. Similarly, it has both been nonsignificant (Ciavarella et al., 2004) and positively related (Zhao et al., 2010) to venture success. As above, inclusion of the processes of customer interaction and experimentation into these models may help explain these divergent findings. We contend that this trait is associated with the entrepreneurial dynamic capabilities of customer interaction and experimentation in that both learning routines are performed iteratively, requiring conscientious diligence to conduct, reflect, interpret, repeat and apply during the conceptualization of a new venture.
Hypothesis 2: Participants who demonstrate high scores in Conscientiousness engage more in a) Customer Interaction and b) Experimentation.

Extroversion

People high in extroversion are energetic and enthusiastic, seeking stimulation from large groups of people. Extroverts are talkative, assertive, and optimistic. Introverts are quiet and independent. While there is some question in the literature as to whether entrepreneurs are more extroverted than non-entrepreneurs (Vecchio, 2003; Zhao & Seibert, 2006), extroverted entrepreneurs demonstrate higher levels of entrepreneurial intention (Hmieleski & Corbett, 2006; Zhao et al., 2010) and venture success (Ciavarella et al., 2004; Zhao et al., 2010) than non-extroverted entrepreneurs. The dynamic capabilities of customer interaction and experimentation both require active enthusiastic engagement with potential customers. Pursuing this engagement repeatedly with authenticity relies on a personality trait that derives cognitive reward from these discussions.

Hypothesis 3: Participants who demonstrate high scores in Extroversion engage more in a) Customer Interaction and b) Experimentation.

Agreeableness

People who score high in agreeableness are trusting and cooperative as compared to someone who is ruthlessly self-interested. Several studies (Zhao & Seibert, 2006; Zhao et al., 2010) have hypothesized that entrepreneurs are not typically agreeable because they are intentionally declaring that existing solutions are inadequate, which drives entrepreneurial intent to create a new solution, and because they must fiercely protect
their own self-interests since nobody else will. However, these same studies did not find any significant relationship between this trait and entrepreneurial intent or success.

The ability to constructively engage in the dynamic capabilities of customer interaction and experimentation presupposes that the feedback from these discussions will be useful. The entrepreneur must trust these routines in order to undertake them repeatedly. Hence, we contend that it is more likely that agreeable entrepreneurs pursue these activities more extensively.

_Hypothesis 4: Participants who demonstrate high scores in Agreeableness also engage in higher levels of a) Customer Interaction and b) Experimentation._

**Neuroticism**

Neuroticism is roughly the inverse of emotional stability. (This scale is sometimes reversed and labeled “resilience”.) Those who score high in neuroticism are anxious, self-consciousness and impulsive. They are prone to and impaired by stress. Those who score low in neuroticism are calm and self-confident, able to shoulder responsibility and duress. With a few exceptions (Ciavarella et al., 2004; Hmieleski & Corbett, 2006), neuroticism has been found to undermine entrepreneurial intention and venture success (Zhao et al., 2010).

We contend that neurotic entrepreneurs will not engage in the dynamic capabilities of customer interaction or experimentation. Entrepreneurs who engage in too many customer interactions and experiments has show a decline in venture success (Ladd et al., 2015). With each new piece of feedback, the entrepreneur may attempt to alter the venture concept and recommence testing these new hypotheses. These vacillations can be mentally and emotionally taxing, which may undermine the entrepreneur’s optimism and
eventually her interest in the entrepreneurial pursuit (Hmieleski & Corbett, 2008). A calm, steady entrepreneur will retain this confidence and optimism and will continue to seek customer feedback.

**Hypothesis 5**: Participants who demonstrate low scores in Neuroticism also engage in **a)** Customer Interaction and **b)** Experimentation.

### Table C1: Big Five in Entrepreneurial Research

<table>
<thead>
<tr>
<th>Dependent variable in study</th>
<th>Source</th>
<th>Openness</th>
<th>Conscientiousness</th>
<th>Extroversion</th>
<th>Agreeableness</th>
<th>Neuroticism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venture success</td>
<td>Ciavarella et al. (2004)</td>
<td>-</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Entrepreneurs vs Managers</td>
<td>Zhao and Seibert (2006)</td>
<td>+</td>
<td>+</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Entrepreneurial Intent</td>
<td>Hmieleski and Corbett (2006)</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Entrepreneurial Intent</td>
<td>Zhao et al. (2010)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Venture success</td>
<td>Zhao et al. (2010)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>0</td>
<td>-</td>
</tr>
</tbody>
</table>

+: positive significant correlation, -: negative significant correlation; 0: no significant correlation, blank.

**Improvisation**

Traits comprise one category of microfoundations. A second refers to the behaviors that are exhibited by the entrepreneur. A microfoundational behavior is independent of the execution of an entrepreneurial dynamic capability or any firm-specific activity; it is exhibited by the entrepreneur in circumstances that are unrelated to entrepreneurship.

This research explores the particular behavior of improvisation, which is defined as the act of extemporaneously formulating and executing novel ideas, relying on the resource at hand (Moorman & Miner, 1998). It is the convergence of design and execution (Baker et al., 2003). The choices that the entrepreneur makes in fast-paced environments rely on heuristics, including abstraction from prior experience to capture *instinctive* reflections.
when there is insufficient time and information for analytical reflection (Davis et al., 2009; Eisenhardt et al., 2010; Tversky & Kahneman, 1974). The capacity to act immediately upon instinct is improvisation.

Improvisation is selected as a focal construct for the following reasons. First, the construct of improvisation has been linked to both entrepreneurial venture performance (Hmieleski et al., 2013; Moorman & Miner, 1998) and personality type (Hmieleski & Corbett, 2008), and so provides an existing foundation of literature upon which to create hypotheses and draw comparisons.

Second, dynamic capabilities are treated as repeatable processes that generate new information. However, one must assume that the new information not only changes the configuration of the firm’s business model but also the expression of the dynamic capability itself. Repeating the same activity to generate the same new information does not improve the efficacy of the reconfiguration. The implementation of a learning routine impacts the entrepreneur’s mental model (Maritan & Peteraf, 2010), which may alter subsequent implementations. Some entrepreneurs have greater facility for incorporating new information to quickly change the details of a learning routine. Within customer interaction, this may manifest as an evolution to the interview script such that the entrepreneur can alter questions from one interview to the next and even in the course of a single interview, improving its flow and utility. Improvisation reflects this capacity to reflect and act extemporaneously, and so is a microfoundation to retain the efficacy of a dynamic capability.

Third, experimentation differs from improvisation in that improvisation entails concurrent creativity and implementation, whereas the design of an experiment may
substantially precede its execution. This juxtaposition of theory implies a juxtaposition of behavior: an entrepreneur with a proclivity for improvisation may intentionally avoid experimentation because it relies on procedural rigidity. Thus, improvisation may have opposite implications for different kinds of entrepreneurial dynamic capabilities, and so inform their differential application.

Improvisation would contribute to the entrepreneurial dynamic capability of customer interaction where the lessons that emerge during a conversation are applied immediately to focus the conversation in more constructive avenues. However, this same behavior may undermine an entrepreneur’s appetite for experimentation, which requires deliberation during design and rigidity during execution.

_Hypothesis 6: Respondents who demonstrate a high proclivity for improvisation are a) more inclined to practice Customer Interaction but b) less inclined to practice Experimentation._

In testing improvisation as a partial mediator between personality traits (using the Big Five) and entrepreneurial intent, Hmieleski and Corbett (2006) find that Openness, Extroversion and Neuroticism are significantly correlated to improvisation. Hmieleski et al. (2013) conclude that optimism, a trait that may be loosely associated with conscientiousness, moderates the negative relationship between improvisation and venture performance such that high levels of optimism worsen the impact of improvisation on performance. Finally, Hmieleski and Corbett (2008) show a positive relationship between improvisation and venture performance when the founder exhibits a high level of entrepreneurial self-efficacy, a trait that is related to neuroticism. We rely on
these findings to construct hypotheses that relate personality traits to the behavior of improvisation.

\textit{Hypothesis 7: Those who show a) high scores for Openness, b) low scores for Conscientiousness, c) high scores for Extroversion, d) high scores for Agreeability and e) high scores for Neuroticism also show a high proclivity for improvisation.}

The ability to adopt improvisational behaviors is contingent upon the entrepreneur’s underlying character traits. Therefore, improvisation may also be a mediator that explains the influence of personality traits on dynamic capabilities.

\textbf{METHOD}

\textit{Research Design}

To test these hypotheses, we collected data from an accelerator program. In general these programs provide concentrated coaching to teams of entrepreneurs who are developing but not yet launched a business venture. In order to efficiently collect data from thousands of participating teams, we relied on survey data instead of direct observation.

\textit{Sample}

This study analyzes the participants and outcomes of an American cleantech accelerator program founded in 2005 to promote entrepreneurial businesses that would commercialize technologies to generate clean energy and clean water, often for consumers at the base of the world’s economic pyramid. The program has grown steadily each year in geographical reach, participation, and notoriety. It now boasts over 3,500 alumni in several sectors of cleantech.
This sample is well suited to test these hypotheses for several reasons. First, these teams are all within the same narrow industrial sector. As a result, they are subject to similar external market trends, allowing us to reduce the number of external factors that might differentially impact our subjects. However, it is important to note that this sample contains ventures that are focused on both end-user customers and middle links in the value chain, such as power plants. Moreover, some ventures intend to build software, which is allows inexpensive iteration, and others intend to build complex hardware, which is less amenable to iteration.

Second, the teams within this accelerator program are all at a similar stage of venture development. Acceptance into the accelerator program requires that applicants submit venture concept, which is evaluated by the accelerator’s staff for initial commercial potential, but have not earned more than $100,000 in gross revenue or raised more than $1,000,000 in investment prior to their application. Thus, the members of this sample all belong to nascent startup ventures. None is a division of an existing corporation.

Third, the entrepreneurs within these teams have similar ambitions. Because the three-month program is time consuming, these entrepreneurs are not pursuing this idea on a whim, nor are they students engaged in an academic exercise. Because the prize for winning the venture competition at the conclusion of the accelerator program is $200,000, we also assume that the participants are not experienced entrepreneurs with successful exits that might allow them to forgo the hurdles and benefits of an accelerator program.
**Unit of Analysis**

The teams within a new venture during conceptualization and prior to actual launch are typically small, averaging 1.6 people per team. In a small group, the leaders of these teams may have an outsized influence of the team’s activities and performance. This person conceives of the initial idea, recruits team members, manages the workflow and team relationships, and makes final decisions around the venture’s evolution. The influence of the founder within the upper echelon of management has been demonstrated to have a significant impact on firm performance, especially for venture teams with only a few members (Hambrick, 2007; Hambrick & Mason, 1984). The unit of analysis within this research is the leader of the venture team based on the assumption that their traits and behaviors are the primary driving forces behind the team’s pursuit of various dynamic capabilities.

**Measures**

*Customer Interaction – Dependent Variable*

Respondents marked their degree of agreement on a five-point Likert scale with two questions as to whether they discussed their venture concept with customers prior to launch a product or service: “We did not talk with customers until the product/service was almost perfect” and “We relied on market research studies to define the venture concept.” These were reverse worded in an attempt to avoid any bias towards social desirability or acquiescence (Podsakoff et al., 2003). In addition, the respondent defined the number of customer interviews that the team conducted during the duration of the accelerator program. By departing from the Likert scale for this item, we hoped to reduce the potential for common method bias (Weijters & Baumgartner, 2012). In order to
normalize the skewed distribution of this variable, the responses were divided into equal quintiles across the sample.

**Experimentation – Dependent Variable**

To assess the team’s engagement in experiments we asked four questions using a Likert scale. The last item was oppositely worded compared to the first two, again to reduce the effects of acquiescence. These questions are adapted from a scale on experimentation in a study of effectuation (Chandler et al., 2011). However, instead of inquiring about general proclivities for various behaviors (“Do you typically do X activity?”), these questions focus on actual activities performed by the team during the conceptualization of their venture during (“During the program, did you do X activity?”).

**Big Five Personality Traits – Independent Variable**

The Big Five were first measured with the 60+-item International Personality Item Pool (IPIP) by Goldberg (1999) as an open-source publically available fee-free scale. We used a shorter 20-item version Mini-IPIP developed by Donnellan, Oswald, Baird, and Lucas (2006), which was reported to provide adequate reliability and validity (Cronbach alphas for the five constructs range from .65 to .77 where N=2,663). Each of the five constructs is measured by four items: two affirmative and two reversed. These reversals are worded both as negations and as conceptual opposites to reduce acquiescence (Weijters & Baumgartner, 2012), despite the possibility that the additional cognitive load may actually increase acquiescence in Big Five surveys (Knowles & Condon, 1999).

**Improvisation – Mediator**

Improvisation is measured with a scale adapted from Hmieleski and Corbett (2008). None of these items was reverse coded.
Controls

We included items to control for amount of education (measured as degrees earned, from high school to doctorate) per Zhao et al. (2005) and age (measured as birth year and then calculated to ascertain the respondent’s age in years at the time of the competition) per Cabral and Mata (2003).

Pre-test

Prior to finalizing the measures for our survey, several entrepreneurs and entrepreneurship educators verbally described their reactions to each question in a “talk aloud” exercise (Bolton, 1993). Ten colleagues then sorted the questions into general categories that aligned with our primary constructs called a “q-sort” (Block, 1961). Thirty MBA students studying social entrepreneurship completed the resulting survey. (None of these pre-test respondents was in our intended sample audience.) Through these exercises, we eliminated several ambiguous words to refine our constructs. Four of the original twelve items for improvisation were highly collinear, and so were eliminated.

Data Collection

We sent the survey via email and paper post to 3,552 alumni of the accelerator program between 2005 and 2014. Of these completed surveys, 176 individuals self-identified as the leaders of their teams (4.2% of all alumni; 5.2% of those who received the email), which is 10.67% of the leaders in the competition, assuming one leader per team. The average age of the respondents at the time that they participated in the accelerator program was 45 years. Eighty-six percent of the respondents were male with an average of at least a master’s degree.
To assess non-response bias, we compared the factor structures of responses submitted immediately after the initial email was sent to the factor structure of responses that were received after a reminder. A confirmatory factor analysis shows adequate model fit including these two groups (CMIN/df=1.317, CFI=.876, RMSEA=.034, PLCOSE=1.00), suggesting that the two groups are configurally invariant. A Chi Square difference test between a constrained and unconstrained model is insignificant (p<.525), suggesting that the two groups are metrically invariant. This demonstration of invariance between early and late respondents is extrapolated to imply that there would also be invariance between those who responded and those who did not.

**Measurement Model**

The pattern structure of an exploratory factor analysis showed several areas of concern regarding validity and reliability. Several items showed inadequate factor correlation of less than .300 suggesting a lack of convergent validity. Others displayed substantial cross-loading showing a lack of discriminant validity. These items were discarded (Hair et al., 2013). Second, the variance for the dependent variable of Customer Interaction is very low (Table C2), which may make statistical findings precipitous. Hence, we elected to treat this variable as a dichotomous categorical multi-group moderator (“high” and “low”) in order to test its effect on other relationships.
Table C2: Construct Descriptive Statistics and Correlations

<table>
<thead>
<tr>
<th>Construct</th>
<th>Mean</th>
<th>S.D.</th>
<th>N</th>
<th>Open</th>
<th>Consc</th>
<th>Agree</th>
<th>Extro</th>
<th>Neuro</th>
<th>Improv</th>
<th>Experi</th>
<th>CustInt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness</td>
<td>2.047</td>
<td>0.309</td>
<td>176</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>1.583</td>
<td>0.484</td>
<td>176</td>
<td>0.012</td>
<td>(.671)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agreeability</td>
<td>3.672</td>
<td>0.679</td>
<td>176</td>
<td>.238</td>
<td>-0.033</td>
<td>(.623)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extroversion</td>
<td>3.226</td>
<td>0.844</td>
<td>176</td>
<td>.200</td>
<td>-0.086</td>
<td>.315</td>
<td>(.660)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroticism</td>
<td>1.528</td>
<td>0.892</td>
<td>176</td>
<td>-0.038</td>
<td>-0.123</td>
<td>-1.58*</td>
<td>(.713)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improvisation</td>
<td>1.730</td>
<td>0.213</td>
<td>176</td>
<td>.448</td>
<td>-.243</td>
<td>.328</td>
<td>.328</td>
<td>-.161</td>
<td>(.561)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimentation</td>
<td>2.814</td>
<td>0.508</td>
<td>176</td>
<td>-0.001</td>
<td>.371</td>
<td>.264</td>
<td>-.150</td>
<td>.168</td>
<td>(.530)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Interaction</td>
<td>0.000</td>
<td>0.668</td>
<td>176</td>
<td>0.058</td>
<td>-0.075</td>
<td>-0.059</td>
<td>0.004</td>
<td>0.023</td>
<td>0.151</td>
<td>0.098</td>
<td>(.360)</td>
</tr>
</tbody>
</table>

*p<.05, ** p<.01; values along the diagonal in () reflect Cronbach's Alphas

For the resulting factor structure, the Kaiser-Meyer-Olkin (KMO) (Cerny & Kaiser, 1977) measurement is .652, which is below the ideal threshold of .8. Moreover, the Cronbach Alpha values for six of the eight constructs are below the ideal threshold of .7 for confirmatory research (shown along the diagonal in Table C2). Alpha values for three of the eight constructs are even below the traditional threshold of .6 that is used for exploratory research. This factor structure accounts for 42.3% of the variance. A confirmatory factor analysis generated excellent model fit (CMIN/df = 1.085, CFI = .971, RMSEA = .022, PCLOSE = .999). Concerns of validity and reliability persist, because the composite reliability and average variance extracted are less than ideal for almost all constructs (shaded cells in Table C3) (Hair et al., 2013).
### Table C3: Reliability, Discriminant and Convergent Validity

<table>
<thead>
<tr>
<th>Variable</th>
<th>CR</th>
<th>AVE</th>
<th>MSV</th>
<th>ASV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvisation</td>
<td>0.573</td>
<td>0.320</td>
<td>0.123</td>
<td>0.053</td>
</tr>
<tr>
<td>Openness</td>
<td>0.743</td>
<td>0.437</td>
<td>0.123</td>
<td>0.032</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>0.726</td>
<td>0.410</td>
<td>0.087</td>
<td>0.024</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>0.672</td>
<td>0.347</td>
<td>0.087</td>
<td>0.035</td>
</tr>
<tr>
<td>Extroversion</td>
<td>0.685</td>
<td>0.436</td>
<td>0.066</td>
<td>0.036</td>
</tr>
<tr>
<td>Agreeability</td>
<td>0.656</td>
<td>0.411</td>
<td>0.066</td>
<td>0.030</td>
</tr>
<tr>
<td>Experimentation</td>
<td>0.536</td>
<td>0.281</td>
<td>0.080</td>
<td>0.025</td>
</tr>
</tbody>
</table>

CR= composite reliability, ideally >.7, AVE=average variance extracted, ideally >.5, MSV=maximum squared variance, ideally>AVE, ASV=average shared variance, ideally>AVE.

### RESULTS

The structural model with the Big Five traits, controls and Experimentation shows adequate model fit (CMIN/df=1.191, CFI=.940, RMSEA=.033, PLCOSE=.971). The relationship between Conscientiousness and Experimentation is significance (p<.05), supporting Hypothesis 2b. In addition, the relationships between Extroversion and Age to Experimentation approach significance (p<.1) (shaded rows in Table C4), providing limited support for Hypothesis 3b. We find no support for Hypotheses 1b, 4b, or 5b.

### Table C4: Standardized Regression Weights of Traits to Experimentation

<table>
<thead>
<tr>
<th>Trait</th>
<th>Weight</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness</td>
<td>-0.09</td>
<td>0.453</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>0.332</td>
<td>0.025*</td>
</tr>
<tr>
<td>Agreeability</td>
<td>0.078</td>
<td>0.548</td>
</tr>
<tr>
<td>Extroversion</td>
<td>0.238</td>
<td>0.076#</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>0.071</td>
<td>0.571</td>
</tr>
<tr>
<td>Age</td>
<td>0.226</td>
<td>0.052#</td>
</tr>
<tr>
<td>Education</td>
<td>-0.039</td>
<td>0.701</td>
</tr>
</tbody>
</table>

* p<.05, # p<.10

The inclusion of Customer Interaction as a multi-group moderator reveals that only Conscientious retains a significant relationship to Experimentation for entrepreneurs who exhibit low scores for Customer Interaction. Those entrepreneurs with high scores for
Customer Interaction only retain a significant relationship between Age and Experimentation. The difference between an unconstrained and constrained model across these two groups is significant (p<.05), demonstrating that the two groups representing High and Low frequencies of customer interaction, are significantly different. However, as mentioned above, we cannot discern if this difference emanates from different structural relationships or different interpretations of the questions as revealed by variance in the measurement model. From these results, we find no support for Hypotheses 1 – 5 a.

Improvisation shows a nonsignificant relationship to experimentation (standardized regression weight = .064, p<.621, CMIN/df=1.283, CFI=.945, RMSEA=.040, PLCOSE=.588), which causes us to reject Hypothesis 6b. (The controls showed no significance.) Moderation by multi-group Customer Interaction eliminates this significance such that neither improvisation nor the controls shows significant paths to Experimentation, undermining support for Hypothesis 6a. Again, there is a significant difference (p<.05) in the model between those who exhibit a high incidence of Customer Interaction as compared to those who exhibit low incidence of Customer Interaction. However, this difference may be due to a variant measurement model.

Two of the Big Five personality traits show significant relationships with Improvisation. As hypothesized, Openness shows significant a positive relationship with Improvisation (Table C5), supporting Hypothesis 7a. Further, also as hypothesized, Conscientiousness shows a significant negative relationship with Improvisation, supporting Hypothesis 7b. However, Agreeability, Extroversion and Neuroticism exhibit
a nonsignificant relationship with Improvisation, causing us to reject Hypothesis 7c, 7d and 7e.

**Table C5: Standardized Regression Weights of Traits to Improvisation**

<table>
<thead>
<tr>
<th>Trait</th>
<th>Weight</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness</td>
<td>0.31</td>
<td>0.03*</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>-0.243</td>
<td>0.071#</td>
</tr>
<tr>
<td>Agreeability</td>
<td>0.135</td>
<td>0.261</td>
</tr>
<tr>
<td>Extroversion</td>
<td>0.118</td>
<td>0.305</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>-0.162</td>
<td>0.176</td>
</tr>
</tbody>
</table>

# p<.10, *p<.05

The inclusion of improvisation as a bootstrapped mediator into the model with traits and Experimentation also generates adequate model fit (CMIN/df=1.157, CFI=.941, RMSEA=.030, PLCOSE=.994). Only Conscientious shows a significant direct relationship with Experimentation in the presence of Improvisation as a mediator (Table C6). However, it shows no indirect relationship. A Sobel test (Sobel, 1982) using the Sopel Calculator (Soper, 2014) shows no support for mediation (p<.37). Therefore, we find that improvisation is not a significant mediator per the criteria from R. Baron and Kenny (1986).

**Table C6: Standardized Regression Weights of Traits on Experimentation Mediated by Improvisation**

<table>
<thead>
<tr>
<th>Trait</th>
<th>Direct</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight</td>
<td>p-value</td>
</tr>
<tr>
<td>Openness</td>
<td>-0.147</td>
<td>0.322</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>0.377</td>
<td>0.04*</td>
</tr>
<tr>
<td>Agreeability</td>
<td>0.063</td>
<td>0.634</td>
</tr>
<tr>
<td>Extroversion</td>
<td>0.223</td>
<td>0.154</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>0.103</td>
<td>0.59</td>
</tr>
<tr>
<td>Age</td>
<td>0.225</td>
<td>0.108</td>
</tr>
<tr>
<td>Education</td>
<td>-0.03</td>
<td>0.816</td>
</tr>
</tbody>
</table>

*p<.05
Multi-group moderation with high and low Customer Interaction on the mediated model with the Big Five traits, Improvisation, and Experimentation shows satisfactory model fit (CMIN/df = 1.231, CFI = .850, RMSEA = .036, PCLOSE = .995). (The relative reduction in CFI is not alarming, given the large number of pathways.) A significant difference (p<.01) between the constrained and unconstrained models implies that there is a significant difference between these two groups. The direct path from Conscientiousness to Experimentation in the presence of Improvisation as a mediator is only weakly significant (p<.1) for respondents who exhibited low incidence of Customer Interaction. None of the other direct or indirect effects of traits is significant for either group of Customer Interaction. Table C7 summarizes the hypotheses and the conclusions from these analyses.
<table>
<thead>
<tr>
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# p>.10, * p<.05, ns non-significant
DISCUSSION

This research seeks to understand the role of personality traits as antecedents and predictors of the entrepreneurial dynamic capabilities of customer interaction and experimentation. This study finds only one such relationship: conscientiousness is significantly and positively related to experimentation. This association may be driven by the requirement that successful experiments are carefully designed and painstakingly executed, with consistency across iterations, in order to validly sense new opportunities. Extroversion also shows a positive and weakly significant relationship to Experimentation. Entrepreneur who authentically enjoy interfacing with customers are logically more likely to pursue them. No other personality traits show a relationship to the two entrepreneurial dynamic capabilities. One interpretation of these results is that the prescribed structure of experimentation allows this entrepreneurial dynamic capability to be efficaciously practiced by entrepreneurs of several different personality types; the procedure overwhelms the expression of traits.

This research also explores the role of improvisation in these two specific entrepreneurial dynamic capabilities. We find that Openness is significantly and positively related to Improvisation as hypothesized and Conscientiousness is weakly significantly and negatively related to Improvisation also as hypothesized. This supports the notion that improvisation provides a foundation for the actor to accept new ideas. However, despite the significant relationships of Conscientiousness with both Experimentation and Improvisation, we do not find a significant direct or mediated relationship between Improvisation and Experimentation. This suggests that the fluidity of improvisation does not encumber the deliberation and contemplation that is necessary
for the design and execution of iterative experiments. The proclivity for this behavior does not infringe upon the implementation of the dynamic capability.

Finally, several the scales within this study are problematic. This is a surprise for the Mini-IPIP used for the Big Five, as well as the items for Improvisation, given their prior reliability in entrepreneurial research. We surmise that sample size (N=176) and sample homogeneity (only nascent entrepreneurs developing an idea in cleantech) may have contributed to the low reliability and validity of these scales. Because we did not find existing reliable scales for customer interaction and experimentation as performed in a specific venture, we created them. Both of these scales captured insufficient variance of their reflective activities due we believe to the overly binary interpretation of the questions. Moreover, the wording of the items may have been insufficiently distinct across constructs, where some respondents may have viewed experimentation as a subset of customer interaction instead of as a different process. Finally, customer interaction and experimentation have been highlighted recently in popular literature such that more recent graduates of the accelerator program may have more familiarity with the terms and activities. People who graduated from the program a decade ago, however, may not share these common understandings.

CONCLUSION

This research has several implications for the study of entrepreneurship. Its first contribution of this research lies in its approach. Instead of focusing on venture success as the dependent variable, it uses selected dynamic capabilities that have been correlated elsewhere to venture success. On a theoretical level, this research bridges the literatures of dynamic capabilities with nascent entrepreneurship. On a practical level, this research
contributes to the growth of successful entrepreneurs, not just successful ventures, through the elucidation of repeatable routines.

As a second implication for entrepreneurship, this study concludes that conscientiousness people are more likely conduct experiments and less likely to practice improvisation. Armed with this knowledge, leaders in venture teams can assign the design and implementation of experiments to those who are empirically conscientious. Moreover, the training for entrepreneurs can be divided and then customized for those who exhibit this trait and those who do not. This research also concludes that such assignment or customization is not necessary for any other entrepreneurial personality traits. Third, while improvisation is not a significant microfoundation of experimentation, there may be other teachable, learnable general skills that do indeed amplify this dynamic capability.

Finally, this research encountered several challenges in the creation of new scales for capturing the nuance and variation in the dynamic capabilities of experimentation and customer interaction.

**Future Research**

First, to address the issues of reliability and validity for these entrepreneurial dynamic capabilities, future studies might collect data from observations of entrepreneurs instead of self-reported retrospective surveys. Continued reliance on survey data will require the development and employment of more reliable and valid scales. This conclusion mirrors that of McKelvie and Davidsson (2009), which also found a need for more distinctive survey questions to highlight nuances within dynamic capabilities in new firms. This renewed call for theoretical and scale clarity is especially important for constructs
relating to customer interaction. Inquiries should assess not just the number of interactions, but also the number and type of hypotheses that were tested within the interviews, the results of each interview on those hypotheses, and the resulting changes to the venture concept. Such scales should be based on clear distinctions between customer interviews and experiments to ensure discriminant validity both in theory and empirics. For example, customer interactions might be defined as conversations that explore the customer’s pain points, but that do not present a cogent solution for customer feedback. Experiments might be narrowly defined as the presentation of multiple discrete, concrete options that require the customer to make an unambiguous trade-off.

Second, research into the link between microfoundational traits and entrepreneurial dynamic capabilities might consider characteristics beyond the Big Five. Promising candidates include self-efficacy, optimism, and proactivity, which have been referenced in other studies of entrepreneurial skills (Chen, Greene, & Crick, 1998; Crant, 1996; De Noble, Jung, & Ehrlich, 1999; Hmieleski & Baron, 2009; Lowe & Ziedonis, 2006).

Third, the weakly significant indications in this study of the conflicting role of improvisation prompts a call for additional research into its link to other independent variables, its role as a moderator, and its role as a dependent variable. Moreover, this study’s measure of improvisation is based on the respondent’s existing proclivity for the practice without regard for the method by which the respondent learned this habit. Such knowledge would help to inform how to best teach improvisation to those who lack the practice.

Finally, further exploration of entrepreneurial dynamic capabilities might address other routines conducted during the conceptualization and refinement of a nascent
business model between customer interaction and experimentation, including the processes of hypothesis codification before the solicitation of customer feedback, and the interpretation of the feedback to validate or invalidate these hypotheses. This search might also be expanded to determine the repeatable learning routines that improve other stages of entrepreneurship prior to venture launch, including assembly of informal advisors and team members and venture pitching. Research might also moderate for new ventures that allow direct, iterative customer engagement (such as end-user software) and ventures that require near-complete prototypes for sale to middle links in the value chain (such as power plant equipment). Such studies might also search for conflicting microfoundations, as well as points of diminishing returns within these dynamic capabilities. The conclusion of such research would be a granular assessment of the skills and characteristics that precede entrepreneurial dynamic capabilities to promote long-term venture survival in rapidly changing markets.
APPENDIX D: BUSINESS MODELS AT THE BOTTOM OF THE PYRAMID: LEVERAGING CONTEXT IN UNDEVELOPED MARKETS

ABSTRACT

Current mainstream theories of business models neither explain nor propel social enterprises serving the bottom of the world’s economic pyramid (BoP), where 4 billion people live on less than US$2 per day and 1.6 billion lack access to electricity. Through interviews with 30 practicing entrepreneurs selling distributed electricity directly to BoP consumers, we derive a new framework of business models for the BoP that emphasizes 1) a market linkage between the customer and the economic activity generated from use of the product; 2) embeddedness of the venture’s offering into the consumer’s social network, daily habits, mental models, and product constellations; 3) pricing based on affordability; 4) growth through replication, typically via franchise; 5) distribution with key partners, social networks, or venture-constructed dedicated avenues; 6) and integration of the influences of government regulation. This framework recognizes the venture’s context to leverage existing systems into its business model, with implications for normative, activity system, and choice perspectives on business model theories. BoP markets are undeveloped, with little competition or infrastructure. With further research, several of the concepts proposed in this framework might also apply to business models in other BoP sectors and in developed, mature, competitive markets.

INTRODUCTION

Of the 4 billion people at the base of the world’s economic pyramid (BoP) who earn less than US$2 per day, 1.6 billion lack access to electricity (London & Hart, 2010). This energy – and the lights and appliances that it enables – is a vital missing ingredient to economic development and poverty alleviation (Galvin & Yeager, 2009). With the advent
of reliable, affordable, and portable technologies to generate small amounts of electricity in close proximity to the point of consumption, hundreds of entrepreneurs have created ventures to provide energy to BoP customers without using a centralized electric grid. Many are performing well: growing revenue, achieving profitability, and scaling operations to other locations (Hart & Prahalad, 2002; Prahalad & Hammond, 2002). Some, however, have performed poorly, with inadequate revenue growth to cover operating costs, resulting in eventual venture closure. In addition to losses for the entrepreneurs and investors, these closures may also leave already vulnerable customers even more impoverished. The consequences of venture failure make iterative “brute force” experimentation with business models a risky, potentially unethical approach in the BoP.

Through semi-structured interviews with 30 founders of successful, struggling, and failed start-ups, this research explores the business models underlying social enterprises that sell off-grid distributed electricity to customers within the BoP. The goal of this application of grounded theory is to discern common characteristics of business models that increase the chance for ventures to succeed in the bottom of the world’s economic pyramid.

We define a business model as an autonomous unit of analysis that specifies the logic with which a firm creates and then captures value. It is comprised of multiple interdependent items to form a holistic system that influences the performance of the firm (Zott et al., 2011).

Several different theories have evolved that apply this shared core definition of a business model. Kalinowski and Vives (2013) categorized these theories into three broad
perspectives: normative, activity systems, and choice. However, none of these existing theories of business models explain or propel start-up ventures serving BoP markets, which are characterized by pre-existing demand for solutions to basic needs, yet with no competition or infrastructure. These conditions obviate the applicability of existing theories. Ventures in the BoP thus require a new framework of business models.

In this paper, we arrive at six primary findings. First, the business models of the BoP ventures in our sample are designed to embed the venture into the customers’ social networks, daily activity cycles, mental models, and existing interdependent products that the consumer already uses, also known as a product constellation. Secondly, they create a market linkage between the customer and the productive output of electricity, which is augmented by the venture’s diligent focus on affordability of the primary product or service, as well as the replicability of the venture in additional locations, typically via franchising. Additionally, because the BoP lacks the infrastructure found in developed markets, these business models construct distribution channels with incentives that are aligned across the venture, its key partners, and the members of the entrepreneurs’ distribution-focused social networks. Finally, many of the ventures sampled are deeply influenced by government regulation, a predicament that is not incorporated into conventional business model theories.

These findings have implications for the three perspectives on business models. Within the normative perspective, because the popular business model canvas (Osterwalder & Pigneur, 2010) fails to capture the business models of our respondents, we have created a canvas applicable to the BoP. The design themes commonly mentioned in the perspective of business models as activity systems are also incongruous with start-
ups in the BoP. We propose other themes based on our findings. Finally, since BoP business models have more porous, opaque boundaries than those in developed markets, we find diminished utility in the choice perspective, which uses the business model as a measure to evaluate the consequences of entrepreneurial decisions.

In order to explore business models in the BoP, this paper first provides an overview of the relevant literature on business models within these three perspectives. It then describes the design of the research, including details on the sample and methods employed to extract themes from the data. These themes are described in our four primary findings. We then describe the implications of our findings to the three existing perspectives on business models. Finally, we conclude by describing the limitations of our study and opportunities for further research.

THEORY

The branch of business research focusing on a deliberate configuration of foundational elements and activities, known collectively as a business model, did not emerge until the mid-1990s and was catalyzed by the boom in internet ventures (Zott et al., 2011), where it served as a holistic approach to describe a firm’s value-creating and value-capturing activities (Osterwalder et al., 2005). During the Dot Com boom, start-up and existing firms faced the challenge of constructing new offerings primarily by innovating on methods of interaction with customers, suppliers, and partners (Magretta, 2002).

A business model describes the core logic for creating and capturing value (H. Chesbrough & Rosenbloom, 2002; Morris et al., 2005; Osterwalder et al., 2005; Zott & Amit, 2010). Unlike business strategy, the business model does not incorporate contingencies for alternative paths of market evolution. The concept nonetheless informs
theories around internal and external value chains, value systems, competitive advantage, strategic networks, theories about firm boundaries and core competencies, and even leadership around the entrepreneur’s own capabilities and aspirations (Morris et al., 2005).

This growing body of research has created a shared ontology that has gained traction in academic and popular circles. Zott et al. (2011) contend that the business model is now recognized as a specific valid unit of analysis, asserting, “There is an increasing consensus that business model innovation is key to firm performance” (p. 20). Moreover, the business model itself can be the subject of innovation, beyond and in addition to product innovation (Doganova & Eyquem-Renault, 2009) to provide competitive differentiation (Christensen, 2001).

Because of the concept’s relative youth, competing theories and typologies of business models have been proposed in the academic literature. Kalinowski and Vives (2013) assert that the literature can be distilled into three perspectives on business models: normative, choice, and activity system frameworks. In this paper, we conclude that our findings have implications for the theories within all three of these perspectives.

**Normative Perspective**

Normative definitions of a business model describe the aspects and attributes that *should* exist in a “complete” business model in order to improve firm performance. This perspective on business models emphasizes learning from application by practitioners instead of explanation by researchers (Kalinowski & Vives, 2013).

While there are several iterations of this perspective, the most popular normative definition of a business model is the Business Model Canvas proposed by Osterwalder
and Pigneur (2010), which is a graphical arrangement of nine elements: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. The authors contend that their framework defines the most significant elements of a venture’s business model. Moreover, by representing these elements simultaneously on a single page, the authors assert that managers can better visualize how these pieces fit into a cogent whole, allowing them to rapidly design internally-consistent models. The Business Model Canvas emerged from several other normative definitions, and contains most of the elements described by its predecessors (Zott et al., 2011).

Other authors have expanded and adapted this canvas (Maurya, 2012). Most of these variants revolve around a graphical layout meant to be viewed on a single page to emphasize the importance of alignment and interdependence among the elements. These frameworks also attempt to contain non-overlapping but collectively exhaustive components of a firm’s logic to create and capture value. In so doing, they implicitly reinforce the contention that the business model is a discrete unit of analysis.
**Activity Systems Perspective**

Zott and Amit (2010) define a business model as a system of interdependent activities, where each activity is comprised of transactions between actors. These actors may span the boundary of the firm; they might be employees inside the firm or partners outside of the firm. The authors state, “The architecture of the firm’s activity systems... captures how the focal firm is embedded in its ‘ecology,’ i.e. in its multiple networks of suppliers, partners, and customers” (Zott & Amit, 2010, p. 3). They specify that the entrepreneur or manager creates these interdependencies with “purposeful design” (p. 3). Although these activity systems might span the boundaries of the firm, they are focused on efforts initiated or controlled by the firm. This theory does not explicitly extend to systems that pre-dated the firm, which may influence the firm’s business model.

The authors highlight four different design themes contained within effective, powerful business models that detail the “value-creation drivers” (p. 6) within the activity system. The authors coin the acronym NICE to identify this list of design themes. Novelty refers to the innovativeness of each activity when compared to other firms within the sector. Lock-In is achieved when activity systems create switching costs or network externalities from which the firm can capture additional value. Complementarities accrue when a firm bundles activities into a system to create additional value that would not have been realized otherwise. Finally, efficiency is gained by reducing the transaction costs between activities that are located within the same system. As we will discuss, our research found that none of these four themes are important, or sometimes even relevant, to the business models of ventures in the BoP.
Choice Perspective

The choice perspective revolves around the belief that the business model “embodies a set of choices… [to] facilitate the analysis, testing, and validation of the cause-and-effect relationships that flow from [previously made] strategic choices” (Shafer, Smith, & Linder, 2005, p. 203). One test of this perspective is to ensure that the choices are internally consistent and mutually supportive of each other, which implicitly recognizes that decisions and their consequences are interdependent. The choices made through a business model can facilitate a virtuous cycle, where feedback loops strengthen aspects of the model at every iteration (Demit & Lecocq, 2010).

In this perspective, the business model is the unit upon which the entrepreneur can experiment. McGrath (2010) contends that successful business models cannot be discerned through analysis, but only discovered through trial and error, especially in highly uncertain environments. Furthermore, change occurs not just within the same firm but across firms as new entrants observe the consequences of the decisions made by predecessors. The business model, then, is a discrete unit of analysis to allow external observers to explain and evaluate managers’ decisions.

METHOD

In this research project, through grounded theory we develop a framework of business models in the BoP. To do so, we interviewed practicing entrepreneurs in order to extract themes from their lived experiences. The goal of this project is to discern the qualities of business models that underlie successful ventures selling off-grid distributed energy in the BoP.
Distributed electricity generation, where the source and use of the power are adjacent to each other, has been lauded as a superior alternative to centralized power systems as it delivers power more reliably, securely, and cheaply, while also accommodating new technologies – especially renewables – with more flexibility. Simultaneously, distributed generation and consumption which does not connect to a centralized power grid empowers entrepreneurial ventures in developed and developing economies (Galvin & Yeager, 2009). Johnson and Suskewicz (2009) argue that new business models will transform the energy industry into successful ventures based on renewable technologies by re-envisioning the entire system, from electricity generation through delivery to payment.

Access to electricity is also a driver for broad economic growth (Galvin & Yeager, 2009) and a necessary ingredient for poverty alleviation because it increases access to modern communications technologies, industrial machinery, modern medicine, and clean water and food that are vital for improved healthcare (Birol, 2010).

We conducted 30 interviews with energy entrepreneurs engaged in selling distributed generation at the bottom of the pyramid around the world. The participants belonged to both for-profit and non-profit entities, but if the latter, the firm generated revenue from sales at a minimum cover operating costs. All of the respondents were guaranteed anonymity; only aggregated or generic details are presented.

The candidates for these interviews were selected from web searches; LinkedIn affinity groups; the Ashoka Foundation, which sponsors entrepreneurs in developing
countries; and the author’s personal network. Initial respondents identified and provided introductions to additional candidates for interviews.

For the purposes of this research, the concept of distributed generation includes microgrids, which are mini-systems that might include multiple types of generation and even limited distribution networks, but within a confined “island” of power that does not connect to the region’s central grid. This study also included solar lanterns, in which the energy-using product is integrated into the energy-generating technology. In all cases, the point of generation is adjacent to the point of consumption.

Of the entrepreneurs interviewed for this research, 43% are based in India, 43% in Africa, and the remainder in the Caribbean or Asia, although the projects that these entrepreneurs have operated encompass a larger area. Forty-eight percent of the ventures are profitable, 37% are generating revenues but have not yet reached profitability, 13% have failed, and 3% are still in concept stage.

Many of the respondents discussed mistakes and surprises, as well as intentional and accidental successes they had encountered in the evolution of their businesses. Few could unequivocally trace improvements to their business models to inspiration, observation, or reaction. Therefore, the findings that emerge in this paper cannot be cleanly attributed to successful or failed ventures. For example, a concept mentioned by only a few entrepreneurs, but as the key to their substantial success would receive as much attention in this paper as an idea mentioned often but with less emphasis. We especially highlight those ideas that are outside of the received literature on business models. This mirrors the research experience of H. Chesbrough and Rosenbloom (2002), who concluded that “The
Even though the research had no intentional bias towards renewable energy, roughly 75% of the ventures employed solar panels, presumably due to the dramatically declining cost of this technology and the simultaneous increase in price of petroleum-based fuels. Sixteen percent relied on biomass to generate biogas, and 7% used hydropower.

**Methodology**

This research employed grounded theory, pioneered by Glaser and Strauss (1967) as the primary means to explore the lived experiences of practitioners (Creswell, 2008). This method of inquiry was selected as it allows theories to emerge from the collected data and evolve as the data are accumulated and analyzed (Glaser, 1992). Van de Ven (2007) adds that, in grounded theory, “intimate familiarity… from rich case studies can provide the information needed to engage in abductive reasoning,” which he defines as “a creative leap in formulating a conjecture… that is the first step… [towards] advance[ing] a new, but yet untested, explanation of how the world works” (p. 177). Because this research aims to discern properties of business models as they emerged through conversations with practitioners in the BoP, a market where current theories have rarely been applied, we deemed grounded theory as the most appropriate approach.

**Data Collection and Analysis**

We conducted interviews from February to June 2013 via Skype audio conference. They typically lasted forty-five minutes. All interviews were conducted in English. We followed a semi-structured protocol (Appendix) in which we asked the respondents to describe the structure, goals, and changes to their ventures at inception, at major
milestones, and at present. The interview protocol did not mention the terms “business model” or any of its typical elements by name in order to avoid biasing the results. We recorded and then transcribed the entirety of the interviews.

We analyzed the data in discrete steps in order to catalog the ideas captured from the interviews. Using Dedoose software (version 4.9), we applied codes (or tags) to excerpts of quotations within the transcripts in three phases – open, axial, and selective – as advocated by Corbin and Strauss (1990). In the first pass, we created and applied open codes that described ideas that we noticed in multiple interviews, without regard to existing theories or conceptual models (Charmaz, 2006; Saldaña, 2012). This process generated approximately 30 codes across 300 excerpts. (In other words, each idea appeared in 10 different instances on average.) These excerpts were not randomly distributed across the interviews; some respondents touched on several different ideas that proved to be common across the sample, whereas others discussed experiences that were not found in other interviews.

In the second pass of axial coding, we aggregated these 30 codes into 10 categories, reflecting the larger themes that emerged from the data. We then re-read the transcripts to verify that these larger codes were justified. In this pass, we found more nuances to these themes, for which we created approximately 10 additional codes.

We then identified the major findings that emerged from the data, as well as an underlying theme that connected all of them together. Our findings were cross-referenced with relevant literature to highlight areas of convergence and divergence. To ensure that our investigation focused on understanding these areas, we created a new set of 20
selective codes based on these areas of convergence and divergence, re-read the transcripts again, and applied these codes *de novo*, without regard to previous passes.

The final pass culminated in a code application table that illustrated the number of instances each code occurred across all of the interviews, as well as list of notable quotations to illustrate the themes found through our coding process. In total, we conducted over 22 hours of interviews across 30 respondents. We read each transcript at least five different times to generate a total of 86 code tags across 657 excerpts. Because some excerpts captured multiple themes, our analysis contained 1316 code applications. Our research identified in six primary findings about BoP business models, which are reported in the following section.

**FINDINGS**

From our conversations with 30 entrepreneurs selling off-grid electricity to consumers in the BoP, we discerned six findings relevant to their business models, including an emphasis on market linkage, affordability, replicability, embeddedness, distribution, and the influence of government regulations. As discussed in the Results section, few of our findings about business models in the BoP mesh with the existing theories of business models found in the literature. However, many of the ventures in our sample neglect or even contradict several of the precepts of extant theories and frameworks on business models.

We also found that a single underlying theme could be extracted from our research: business models of successful BoP ventures are informed and strengthened by an appreciation for the complex context in which they operate. This phenomenon has been noted in regard to the economic system of the market (Seelos & Mair, 2007), but not in
detail around the pre-existing systems relating to the consumer. Where applicable, the following descriptions of each of the findings discuss this underlying theme. It will also be treated in more detail in the Results section of this paper.

**Finding 1: BoP business models seek a market linkage between the product’s use and the customer’s increased earned income.**

Several entrepreneurs in our sample require that prospective customers have a market linkage, where new access to electricity must increase users’ economic activity. Simple demand, even coupled with ability to pay, is not enough to prompt business founders to provide the product or service to potential customers. Their business models focus on customers who will be able to use the electricity to not only increase productivity, but also profitably sell this higher output, thereby having an impact on the longer-term goal of poverty alleviation. Figure D1 contains anonymous quotations from entrepreneurs within our interviews.

**Figure D1: Excerpts about Market Linkage**

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<td>We make sure that there is a market linkage for that extra production [from the electricity we provide] otherwise we’re not going to sell it.</td>
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<tr>
<td>[We demand a market linkage to] ensure that we’re not bogging down their [micro-finance institutions] clients with additional debt that they don’t know about.</td>
</tr>
<tr>
<td>[A failure to require a market linkage] unnecessarily [puts] technology on to the poor. That’s exactly one of the philosophies of the failures of the microfinance industry in India. They blindly went in giving [credit] without realizing that was not the priority for certain set of the segments.</td>
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One energy entrepreneur’s venture has grown consistently in reach and sophistication to hundred of locations, providing energy for hundreds of thousands of people in the BoP. Yet his business model does not have pre-established demographic descriptions of potential customers. When customers approach him to construct a power plant in their village, he studies the potential for electricity to both stimulate economic output and to generate returns for the customer. For example, he refused to build a micro-power plant
in a community of weavers, despite their ability and willingness to pay, because he
determined that it was too distant from the nearest clothing market. The revenue from an
increased production of cloth from the introduction of electric sewing machines would be
swallowed by transportation costs to get the cloth to market. He concluded, “the [market]
ecosystem was completely missing.” The construction of a power plant might raise
productivity and access to amenities, but it would also exacerbate the perpetual
indebtedness of the community to its lenders.

Some respondents advocate for a market linkage because they feel an ethical
responsibility to vulnerable consumers within the BoP. Others establish a market linkage
because they view it as self-interested protection of the economic system in which they
operate. By ensuring consumers generate economic returns from their electricity
purchase, it is more likely that they can repay their loans to local banks, who in turn are
more likely to lend to the entrepreneur’s future customers. This latter justification
demonstrates recognition by the entrepreneurs that their business models operate within
an existing system. Some of the inherent choices codified within their business models,
therefore, may not have a lasting impact on their own businesses, but they could have
potential consequences for other actors within the market. This concept of market linkage
was not found in a preponderance of respondents, but those who discussed it viewed it as
a crucial, fundamental component of their venture’s business model and its success.

**Finding 2: BoP business models set prices based on affordability.**

In mature markets, price levels can be set based on value, cost, competitors, or a host
of other options. In the BoP, twenty respondents in our sample declared that affordability
was the basis for their pricing and a vital attribute to their offering, to their personal ambition, or to their efforts to improve economic conditions in the BoP.

The respondents in our research described three avenues to achieve affordable prices. First, they design their products and services for low cost. Several entrepreneurs manufacture equipment in China to minimize costs at scale, despite their personal desires to manufacture locally to generate employment. One entrepreneur is designing a solar lantern where many of the parts are sourced from local trash – an empty soda bottle as a lampshade, or a tin can as the housing for the electronics – to reduce product cost and thus price.

Credit is the second path for affordability for electricity generating products and services. In the BoP, credit is rare. Even for equipment that has clear opportunity for providing significant economic gain, most consumers cannot afford the initial up-front purchase price. As one entrepreneur declared, “You cannot build poverty-destroying infrastructure by trying to sell stuff for cash.”

The primary method for entrepreneurs to provide credit to BoP consumers is to partner with microfinance institutions (MFIs), which offer small amounts of credit at moderate interest rates – from 15% to 30% annualized – to help customers purchase vital products without struggling to pay a large up-front price. Several ventures in our sample rely on MFIs to provide loans to consumers to purchase electricity-generating products or services. A few leverage the social networks of MFIs (discussed below in Embeddedness) and a few attempt to use MFIs for distribution, but with limited success (discussed below in Aligned Distribution).
Credit vehicles, however, still face challenges in the BoP. Repayment of loans is typically compelled by social pressure, which has its limits. Legal recourse is not feasible due to the absence of efficient contract law and the small size of individual loans. Furthermore, in some regions, consumers dislike the notion of debt (see Mental Models below). Moreover, there is a temporal mismatch between debt payments, which must be made on a periodic schedule, and typical BoP household income, which is highly unpredictable and variable and thus makes adhering to a regular payment plan difficult.

To address these challenges, several entrepreneurs have adopted a third strategy to achieve affordability: pay-as-you-go (PAYG) business models. In a typical PAYG transaction, the customer purchases a specially-designed solar lantern at a deep discount, and then purchases “light” credits to allow the light to operate. Payment is made through the customer’s mobile phone. After purchasing light credits, the mobile phone communicates with the solar lantern to verify and store the credits. The credits are then billed through the mobile phone carrier, with payment made to the solar lantern manufacturer. If the customer does not refill his “light” account, the solar lantern ceases to operate. Most ventures set a threshold of credits over which the restrictions are removed, and the solar light operates without further payments. (This is akin to a “rent-to-own” model.)

These ventures also typically reduce the price per hour of “light” if the hours are purchased in bulk by intermediaries for resale in smaller amounts to equipment owners. This discount reflects the value of these larger infusions of revenue to the company. One company is now experimenting with other discounts for referrals and for consistent, regular purchases.
The advent of widespread mobile phone use and new technologies to allow the mobile phone to communicate with the electricity product have created this new category of PAYG models to dramatically reduce the initial price of energy products, making them affordable to BoP customers. The operators of these ventures acknowledge the irregular timing of income for their potential BoP customers, and have created both a product and business model to accommodate it.

Finding 3: BoP ventures grow by replicating their services in multiple locations.

Ventures in the BoP have several options for how they can drive and manage growth, from adding new services for current customers to seeking new consumers of the existing service (London & Hart, 2010). With few exceptions, most of the entrepreneurs within our sample (Figure D2) who discussed growth strategies focused on replication via franchising, where an entrepreneurial franchisee injects additional capital into the firm for product manufacturing in return for the right to sell the product. The franchise owner and the franchisee split the profits of the sale, so both have incentives to grow sales.

Figure D2: Excerpts about Replicability

<table>
<thead>
<tr>
<th>Everybody is so worried about scale. Everybody’s got to get to scale. It’s the new five-letter word. The thesis that I would argue is that it’s replication. Own the core and franchise growth.</th>
</tr>
</thead>
<tbody>
<tr>
<td>We can do several hundred power plants and manage it ourselves with our few operating partners. To really make it scalable, where our target is to change the lives of 10 million people, is not going to be possible without massively franchising it.</td>
</tr>
<tr>
<td>You’re much better if you’re relying on the entrepreneurial incentives that come with a franchise because then it’s his [the franchise owner’s] bottom line he’s driving, ideally to maximize sales.</td>
</tr>
<tr>
<td>We found the dealer model was too loose in terms of controlling standard operating procedures specifically to do with installation and after sales service and complaint handling. We found a franchise was a good middle ground where we got entrepreneurship at a local level.</td>
</tr>
</tbody>
</table>

Several respondents described franchising as the solution to managing new field offices in remote locations. Geographically, the new offices are too distant to allow the founder to monitor or oversee employees according to standard operating procedures. At
the same time, these respondents believed that a wholesale distribution or dealer model, even when feasible, necessitates relinquishing oversight of the product’s branding, messaging, and priority within the distributor’s channel. They concluded that franchising to a qualified entrepreneur strikes an adequate balance between these two extremes.

Once a site is large enough to cover its own fixed administrative costs, one entrepreneur intentionally turns the business over to a franchisee in order for the founder to focus on developing new sites. This approach meshes with his ambition to extend access to electricity to as many people in the BoP as possible; he has no desire to continue to focus on growing consumption per user in an existing site.

In another example, for a venture generating electricity from biomass, growth at a single site can exceed the availability of feedstock. Thus, he elects to start new sites at a distance – and maintain steady electricity demand at his existing sites – because his upstream value chain requires it. Once these new sites are operating at the capacity of the available feedstock, he intends to transfer them to a franchisee owner so that he might replicate the venture elsewhere.

**Finding 4: BoP business models embed the product or service into the lives of their potential customers.**

Twenty-two entrepreneurs in our sample intentionally designed their business models to embed their ventures’ products deeply into consumer lives. London and Hart (2010) define the embeddedness of a business model as its “capability to gain a deep sense of the social context and a detailed knowledge of the intrinsic economic rationale of the local economy” (location 1108). The influence of the economic, institutional, and communal structures on the entrepreneur’s business model has been noted by Seelos et al. (2011)
and Jack and Anderson (2002). These authors, however, provide no more detail on how embeddedness is tactically manifested in the consumer and leveraged by the entrepreneur. Below, we extend their definition into four practical areas of the consumer’s experience: social networks, daily habits, mental models, and product constellations.

**Finding 4.1: BoP business models reply on consumers’ social networks as the primary means of marketing new services.**

None of the ventures in our sample engage in formal marketing, typically because there are few established avenues for market-wide communication. Instead, for fifteen of the respondents (Figure D3), news of their products travels through social networks, creating inquiries that drive sales. The business models that leverage social networks do not rely on serendipity. They create deliberate elements that incorporate and capitalize on these rich networks. Primarily, this tactic is exhibited through the hiring of sales people who are selected for their existing networks as well as their ability to grow them.

**Figure D3: Excerpts about Social Networks**

<table>
<thead>
<tr>
<th>Students of the sector who were always looking for those [sales] networks and learning as they went into the market were probably the ones who were the most successful.</th>
</tr>
</thead>
<tbody>
<tr>
<td>When they become a [micro] entrepreneur, we provide them with sales training and we help them map out ‘how are you going to reach 100 sales?’ We help them do a map. ‘Who’s in your family? How about your husband’s cousins? How about your cousin’s brother?’ [We] draw a picture of their social network.</td>
</tr>
<tr>
<td>These are people who are selling things like life insurance, health insurance in rural areas. They’re sometimes banking correspondents for financial institutions that are trying to reach deeper into rural areas. We tap into them as lead generators so they’ll generate leads for us in rural areas.</td>
</tr>
</tbody>
</table>

According to several respondents in different regions of the globe, a gender delineation exists around purchase decisions. Typically, men are responsible for earning cash and purchasing complex products. Women manage the home, which includes the provision of cooking fuels such as kerosene or dung. This responsibility requires multiple trips per week to purchase fuel whenever the household’s cash accumulation allows.
Since household lighting principally originates from the cooking fire, women are the primary targets for modern residential off-grid energy systems that generate light. This reality is accompanied by some challenges: because women do not travel far from their villages, it is difficult for non-local companies to find and present them with messages about new products. Distance exacerbates another problem as well: managers in the company headquarters cannot determine which marketing messages would be the most effective for any particular potential customer.

One entrepreneur solved these dual challenges by creating a sales force of local women, each of whom operates her own small business of solar lanterns. These micro-entrepreneurs (also called “village-level entrepreneurs,” or VLEs) receive substantial training and ongoing support from the firm, as well as wholesale pricing for the products. The micro-entrepreneurs then leverage their own networks to demonstrate and sell the solar lanterns, pocketing the margin.

Several respondents who employ this sales strategy found that health care workers and schoolteachers are consistently the most productive micro-entrepreneurs because they already know many other women in the village and possess credibility for their prowess in social improvement. The micro-entrepreneurs, all sincere consumers and thus effective evangelists for the product, are free to customize the marketing messages for their audience, focusing on the lantern’s positive economic benefits, safety, or luminosity. Because these micro-entrepreneurs live in the same neighborhoods as their customers, they are immediately available for post-sales service. If this service call invokes a product warranty (a rarity in many of these regions), the micro-entrepreneur can explain and facilitate the return.
These entrepreneurs incorporate social networks into their business models to build awareness and sell their product, often because it is the only method available.

**Finding 4.2: BoP business models mesh with customers’ daily or seasonal habits and activities.**

Several ventures intentionally structure the delivery and pricing of their products to mirror the products that they intend to replace. This emphasis on customer activity cycles is especially pronounced in pay-as-you-go (PAYG) business models. This alternative pricing scheme (Table D1) is analogous to the traditional cash requirements of kerosene, the fuel source that the light is replacing, as well as prepaid mobile phone airtime upon which this lighting technology depends.

**Table D1: Comparison of Purchase of Lighting Substitutes**

<table>
<thead>
<tr>
<th></th>
<th>Kerosene</th>
<th>Simple Solar Lantern</th>
<th>Mobile Telephony</th>
<th>Pay-as-you-go Solar Lantern</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Up front payment</strong></td>
<td>Small cash</td>
<td>Large cash or loan</td>
<td>Small cash</td>
<td>Small cash</td>
</tr>
<tr>
<td><strong>Cap on use</strong></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Share/resell</strong></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Instant result</strong></td>
<td>Yes</td>
<td>Maybe with loan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

These entrepreneurs constructed their business models to embed their ventures into the consumers’ daily (or weekly) activities and habits, so that the consumers are performing the same physical actions – going to the same places on the same schedule with the same results – as they had performed for purchasing non-electricity-generating fuel types (Figure D4).
The appeal of embedding a business model into consumer activity patterns extends beyond pricing. One entrepreneur selling off-grid electricity to provide lighting to rural households has created a distribution system around portable batteries with a centralized recharging station in order to maintain the daily habits of consumers who are accustomed to frequent trips to purchase kerosene in a central market.

Another entrepreneur has constructed his business model based on the existing activity cycles of government agencies. The ministries of health and education pay for monthly electricity in urban areas where their facilities – clinics and schools – are connected to the grid. In remote areas with no central grid, these ministries attempt to operate their own electricity generation stations, but often fail because this service is outside of their competence or is not a priority. This venture constructs and operates these generating stations and then invoices the relevant ministry for the amount of power consumed, mirroring the method already used by the government in urban areas.

Finding 4.3: BoP business models incorporate potential customers’ existing mental models.

The activity cycle highlights the physical actions and daily or seasonal habits of the consumer. These activities rely upon the mental models of consumers, which embody the assumptions, preconceptions, and vocabulary that inform their perceptions about the world around them. Gentner and Stevens (1983) describe mental models as “people's
views of the world, of themselves, of their own capabilities, and of the tasks that they are asked to perform, or topics they are asked to learn.” Hargadon and Douglas (2001) relate the concept of mental models to entrepreneurial activity, noting that innovations must “invoke the public familiarity with the technical artifacts and social structures of the existing [systems of products or services]… to locate their ideas within the [existing] set of understandings and patterns of actions” (pp. 477-478). Just as mental models inform a consumer’s physical activities, these activities create new realities in the market place, which in turn generate new mental models. As a result, mental models are not static (Giddens, 1984). Indeed, even though several business models incorporate the extant mental models of the population of potential customers, the goal of many entrepreneurs in our sample is to facilitate evolution of these mental models.

One founder had initially provided products to micro-entrepreneurs on commission, based on the assumption that they would sell the inventory to maximize their own profits. However, many salespeople did not generate turnover. They did not have the same mental model as the founder, which automatically grasped economic opportunity. Instead, the founder discovered that the micro-entrepreneurs did not have a drive to generate upside profits. To alleviate the unproductive inventory costs, the founder of the venture moved to a wholesale model and provided guidance to the micro-entrepreneurs for retail pricing. This shift in approach triggered a different mental model in the micro-entrepreneurs. The founder then had enough momentum to implement this wholesale pricing change, based in part upon the success of early micro-entrepreneurs who shared their confidence with newcomers. This adjustment to align with the micro-entrepreneurs’
mental models helped to evolve the business model from micro-consignment to more of a micro-franchise (see Replicability above).

This same founder encountered this mental model again in a different context when working with one of her micro-entrepreneurs, who would only sell products until she generated enough commission to pay for her children’s school fees each month. This behavior required that the founder relax quotas in regions where the company’s warehouse expenses were already being met by other micro-entrepreneurs. The founder observed, “Because of that [incident], we realized that we don’t have to dictate what success looks like.” Instead, she reflected, “Sales and [customer] behaviors are unpredictable, so the most important thing I can do is create a business model that has a lot of flexibility in it.”

This incorporation of the customer’s mental model applies to ventures using pay-as-you-go business models, as well. As mentioned above, the PAYG entrepreneurs in our research construct their business models to intentionally mimic those of kerosene and mobile telephony, both in regards to activity cycles and mental models. They find that potential consumers are more open to a PAYG product because they already understand and enjoy the concept from their mobile phone plan. One venture even emulates the wording of local phone carriers in the text messages that it sends to customers. He explained, “The closer that you mimic what either the telecom operators do with prepaid mobile airtime or the satellite dish TV companies do with their pricing model and incentives, then the easier it is for people to understand.”

Finally, one entrepreneur discovered that consumers in her region had strong cultural beliefs against carrying personal debt, which they saw as a declaration of an inability to
care for oneself. “Debt is not a sin exactly,” the founder said, “but it’s pretty damn close.”

This entrepreneur was forced to consider other approaches to product affordability.

**Finding 4.4: BoP business models integrate into or build the consumers’ product constellation.**

Electricity by itself has no value. The ventures that sell electricity, therefore, seek customers who already own products that require electricity, or their electricity-generating products are accompanied by appliances that use electricity. For example, most ventures offer for sale low-power lights and charging units for mobile phones along with the generator. A few ventures also sell radios and low-power televisions. One even provides refrigerators and sewing machines on credit. Sales of these ancillary appliances create additional revenue directly, as well as ensure greater usage of electricity, which can drive more revenue to invest in additional generating capacity.

By explicitly recognizing the customers’ product constellations in their business models, these BoP entrepreneurs recognize the opportunities and constraints that emanate from the customers’ existing possessions. This reality is rarely mentioned in contemporary theories of business models for mature markets, but was discussed by 10 respondents in our sample.

In conclusion, our research found that ventures in the BoP embed aspects of the customers’ lives into their business models to drive sales. They harness social networks, mimic daily activity cycles and habits, leverage existing mental models, and integrate into existing product constellations.
Finding 5: Distribution is a vital element in BoP business models.

Unlike in mature markets, distribution is one of the key challenges to serving consumers in the BoP. Seventeen of our respondents declared that distribution – especially the “last mile” from warehouse to consumer – is vital to their business success (Figure D5).

**Figure D5: Excerpts about Distribution**

<table>
<thead>
<tr>
<th>Our distribution partners are our key partnerships, so we are working on nourishing them. At every step on the way, we’re really focused on aligning incentives. Everyone in the value chain is buying this.</th>
</tr>
</thead>
<tbody>
<tr>
<td>We had some really good success with bringing together very remote rural supply chains to get the product to consumers … as well as finding banks or MFI’s [who] would finance [the purchase]. When you bring those two things together you get a very rapid rate of diffusion. There are so many breakdowns and so many weaknesses in infrastructure here that the companies that figure out ways to push that or to overcome that in the right direction, find a way to do that, because they’ve learned how to manage effectively… [will succeed].</td>
</tr>
</tbody>
</table>

The ventures in our sample employ three different methods for distribution. Some rely on key partners to distribute their goods, where the business model has been designed to ensure aligned incentives. Others create and operate their own dedicated distribution channels. Still others rely on social networks as their distribution avenue.

**Finding 5.1: Some BoP business models rely on key partners for distribution.**

Some entrepreneurs in our sample maintain contractual relationships with large, distribution-focused partners. One entrepreneur declared, “We sell exclusively to one partner in each country, and we work with them to make sure that their pricing model is appropriate for the local market.”

Another venture distributes exclusively through mobile phone carriers in a symbiotic relationship. Mobile phone customers without any access to energy at home have no way to charge their phone. Not only does an uncharged phone inconvenience the customer, but the phone company also loses the device necessary for the consumption of airtime.
and the commissions that accompany mobile phone-based micropayments, which are becoming popular in remote areas that lack access to banking infrastructure.

Several ventures address this problem by including a mobile phone charging port within their portable solar lantern. However, some customers have neither the desire nor ability to pay for lighting; they only want to charge their phones. Some cannot afford the solar lantern anyway, either because they do not qualify for micro-loans or because they live in regions where micro-financing institutions (MFIs) are still rare.

One venture in our study elected to confront this problem by understanding and engaging in the system from the perspective of the telecommunications carrier. The carrier operates primarily through retailers; for example, a local food store might also sell mobile phones and airtime credits. While the carrier drives marketing, it has no direct proactive connection to end-consumers. This start-up venture designed a portable solar charging station, complete with a battery for storing energy. Its business model now focuses on selling the product to the mobile phone retailers by way of the carriers, which market the solar charger to its network of retailers at no cost or for a commission. The retailers purchase the unit and then offer mobile phone charging to end-consumers for a fee. Some retailers even offer charging for free, knowing that a charged phone will generate airtime usage and micro-payment commissions, of which the retailer gains a cut. More recently, the start-up has included lights in its charging station to help retailers stay open after dark, prompting a surprisingly large jump in retail sales. In short, all three entities – the venture, the carrier, and the retailers – have a common incentive to keep mobile phones charged with electricity.
Finding 5.2: Some BoP business models leverage consumers’ and salespeople’s social networks to distribute products.

Within micro-finance institutions (MFIs), potential consumers form self-help groups (SHGs), which are social networks of neighbors and friends who exert pressure on each other to repay loans. (In some cases, the SHGs pool their resources in order to make purchases without borrowing outside capital.) These groups then meet with MFI representatives who provide a catalog of products for sale. MFIs may also bring salespeople from other ventures to demonstrate and offer a product for sale, coupled with a micro-loan.

The MFIs are organized in hub-and-spoke networks, where field representatives each cover a large territory and several hundred SHGs and report back to a regional office. Recognizing the value in their connections with customers and credit facilities, several MFIs also sell products, which are usually high-volume, low-cost, health-related items.

These MFIs would appear to be ideal partners to distribute products for off-grid energy companies. The system seems to have all of the elements needed to close the gaps in entrepreneurs’ ventures. However, several respondents in this study discovered that MFIs are not ideal distribution partners for off-grid energy ventures.

First, the representatives are fully engaged with providing loans and selling simple products. They lack the product-specific training to adequately convey the value of more complicated energy products. The provision of loans and collection of payments already provides these MFI field representatives with an overloaded work schedule and a satisfying income. Second, many MFIs rotate field representatives to new territories in order to reduce the possibility of corruption. As a result, off-grid energy providers relying
on MFIs for customer connections and distribution would need to retrain field representatives frequently, and then wait for them to establish trusting relationships with SHGs. Third, even when their hub-and-spoke systems are amended to accommodate the distribution of larger products, MFIs are not equipped to handle post-sale customer service and returns. The MFIs’ hub-and-spoke systems only operate in one direction, which is problematic in this case.

**Finding 5.3: Some BoP business models must construct their own dedicated distribution chains.**

Instead of relying on partners or social networks to provide distribution, a few ventures in our sample were forced to create their own dedicated supply and distribution channels.

One venture in our study converts accumulated pine needles into power. The process begins when the local pine forest drops its needles. In the past, these needles have caught fire and destroyed property and livelihoods. For a variety of reasons, the fires have become more severe and more frequent in recent decades. This entrepreneur’s venture employs local farmers outside of harvest season to collect pine needles, which are then ground, compacted, and pyrolyzed (i.e. burned) to create biogas. Because the venture’s feedstock, employees, and generation facilities are all focused on a small geographic area, the company must perform all of the functions within its supply chain.

Several ventures within our sample sell branded batteries. These batteries are recharged at a central facility (usually connected to the grid for low-cost power) and transported by company employees to remote villages or even to consumers’ homes to connect to household-only micro-grids that power lights and small appliances. These
ventures must operate their own dedicated distribution channels because no pre-existing channels or partners existed who were already making deliveries of similar size on similar schedules in the regions where they operated.

In conclusion, distribution is an enormous challenge for BoP ventures engaged in selling energy products and services. The ventures in our research rely on key partners, social networks, or their own dedicated channels to deliver products the “last mile” to consumers.

Finding 6: BoP business models incorporate and anticipate the influence of government regulations.

It is no surprise that government regulations exert significant influence over business models in both mature and undeveloped markets. Few of the existing theories of business models incorporate this influence. Several respondents in this research stated that government programs factored heavily in the design and implementation of their business models.

Even though several respondents receive government subsidies for selling electricity-related products, most of the anecdotes described deleterious government actions. Several ventures had achieved success in selling off-grid products, thereby attracting the attention of the national government or international organizations like the World Bank. Seeking broader impact and popularity, these external entities injected free products on BoP consumers. This action eliminated demand for the existing revenue-generating businesses, which were forced to fold altogether or delay resumption of sales until the free products had been absorbed.
Several entrepreneurs recognized the predilections of their local governments, and adapted their business models to incorporate this context. For example, before one venture constructed a hydroelectric plant to provide power to an entire village, it secured broad community consensus around how profits from the isolated micro-grid would be invested into economic development. When the national government saw a village with electric appliances (and thus immediate demand and paying customers), it chose to extend the central grid into this community. Because of this pre-existing consensus, the community as a whole refused to purchase electricity – even at a lower price – from the government until it promised to purchase the output from the local venture at a reasonable price.

Another entrepreneur chose a different business model to counter a similar threat. This venture constructs mid-sized power plants in developing countries. It borrows money from large banks to pay for the up-front construction costs and then repays the loans from sales of the generated electricity where the price is set by government policy. Instead of selecting a loan from interested foreign investors – despite their experience with the technology risks involved in these projects – the entrepreneur accepted investment from in-country banks. Their reliance on repayment prompted them to pressure the government – of whom they are powerful constituents – to refrain from changing regulations that might endanger sales. In this instance, understanding the proclivities of the government resulted in a more stable business model. In conclusion, the experiences of the respondents in this research compel us to recognize the importance of government regulations when designing business models for the BoP.
CONCLUSION

The findings of this study have implications for several different aspects of business models engaged in selling off-grid electricity to consumers at the bottom of the world’s economic pyramid. We organize these implications into the three perspectives on business model theory discussed initially.

Implications for the Normative Perspective

For the normative perspective, which prescribes elements of a business models, ideally in a single graphic, we extract from this research a framework (Figure D4) to explain and propel business models for ventures at the bottom of the pyramid. Just as with the Business Model Canvas from Osterwalder and Pigneur (2010) and the Lean Canvas from Maurya (2012), this framework, a BoP Canvas, is intended to highlight the vital elements and logical connections by which firms at the BoP can provide value to their customers.

This framework incorporates our findings described in the above section. Our entrepreneurs constructed their business models to emphasize a market linkage between their product and the positive gains that the customer would garner from the product through sales of its output into the market. In the BoP Canvas, this linkage is encapsulated in the connection between the firm’s solution and its impact. This impact may also be measured against other goals that the entrepreneur established for the business. This idea is captured with the Purpose and Metrics element, which was included in Maurya’s 2012 lean canvas. This BoP framework also includes an element emphasizing product affordability, as well as an element to stress growth through replication.
Based on the BoP ventures in our sample that designed their business models to embed aspects of the customers’ lives, this BoP Canvas contains four elements of embeddedness: social networks, activity cycles, mental models, and pre-existing product constellations. These concepts are complex systems that already exist in the customers’ experiences. The BoP entrepreneurs in our research have incorporated these contextual elements into their business models.

Our BoP canvas also contains elements relating to distribution, which could be comprised of social networks, key partners, or a dedicated channel. Finally, it incorporates an element for the influence and anticipation of government regulations.

This BoP Canvas can be divided into quadrants. The left side of the canvas relates to items revolving around the individual customer: the solution (i.e. product or service) is aimed at the customer, along with ability to embed the solution into the customer’s pre-existing systems of networks, activities, preconceptions, and products. The items on the
right side of the BoP Canvas relate to the broader market beyond the individual customer and even beyond the sector in which the firm operates, from governmental regulations to distribution to firm replicability.

The top section of the BoP Canvas contains elements that focus on the specific product, including its purpose and an explicit description of the solution, as well as elements to explain its affordability and how it will scale through replication. The bottom section of the BoP Canvas relates to systems that already exist in the environment, prior to and even independent of the product or the firm, from key partners to assist in distribution to the influence of government regulation.

The social networks at the center of the BoP Canvas form a nexus where all quadrants overlap. They are important for both the individual customer and the market. The former illustrates the venture’s ability to embed its products into the customer’s social networks to build awareness and acceptance. The latter relates to securing an avenue for distributing the products in a broader market. They are both specific to the product at hand and also existed prior to the introduction of the product. They epitomize the importance that the BoP entrepreneurs in our samples place on building their business models to align with the contexts of the consumers.

**Implications for the Activity Systems Perspective**

This perspective describes business models as the set of activities that occur inside of and around a firm to create and capture value (Zott & Amit, 2010). However, theories within this perspective assume that these systems are designed and driven by the entrepreneur. From our research, we find a vital role in BoP business models for the systems that exist independently of the firm and usually pre-date the firm. Indeed, those
ventures that actively incorporate context into their business models seem to have more success in the BoP market for off-grid electricity.

The elements within the BoP Canvas are not just items worthy of the entrepreneur’s attention. Our research demonstrates that they are also important drivers of venture success. As discussed earlier, Zott and Amit (2010) list four “design themes” that are present in successful business models in mature competitive markets: novelty, lock-in, complementarities, and efficiency. While these might be appropriate goals for business models in mature, competitive markets, we conclude from this research that they do not apply to business models in the BoP. Without competition, novelty is not valuable. To the contrary, we found that successful ventures imitate the business models of the products they seek to replace in order to mesh into the customer’s product constellation, habits, and mental models. Hence, we propose embeddedness instead of novelty as a crucial design theme.

Lock-in creates customer-switching costs to force loyalty to a venture. In the BoP, ventures fail often. Because their customers are extremely poor, London and Hart (2010) advise entrepreneurs to construct solutions and business models that can elegantly degrade to cause minimal disruption if they fail. Moreover, explicit efforts to lock in BoP customers may repel them, causing them to continue to forego consumption. Instead, we found from an adamant minority of our respondents that an emphasis on a market linkage will not only propel initial purchase, but also ensure that the customer repays loans and keeps venture partners satisfied.

Complementarities refer to activities that are better performed within the same firm than in different firms. In the BoP, there is no consistent infrastructure to provide
distribution, making this a key challenge for entrepreneurial business models. Many ventures relied on key partners or social network to deliver products the last mile. Only those with no other choice build dedicated distribution channels. As a result, complementarity in the BoP is often dictated by the context, and not an option for the entrepreneur to consider.

Efficiency, which emphasizes the reduction of transaction costs between actors, remains important in the BoP, but it falls from its place as a central tenant. Certainly, all ventures strive for efficiency, but within the BoP, efficiency may be a luxury. None of our respondents mentioned it as a key challenge to their businesses.

The common themes that emerged from the majority of the entrepreneurs in our study - distribution, affordability, replicability, and embeddedness- create a new acronym for important design themes for BoP business models: DARE.

**Implications for the Choice Perspective**

The choice perspective regards the business model as the lens through which we can analyze the path of choices made by a firm’s managers. It assumes that the business model is a discrete unit of analysis, against which one can track changes and the consequences of those changes. We found in our research that business models in the BoP incorporate pre-existing complicated systems – from customer mental models to government regulation – which make the borders of the business model opaque and porous. Indeed, a theme underlying many of the findings of this paper is the entrepreneurs’ incorporation of context into their models. For example, a business model that explicitly relies on the social networks of the consumers to build awareness and subsequently to distribute products has expanded its arena of action outside of what it can
control or even observe. Similarly, a business model that requires a market linkage between the customers and their income-generating economic activities that flow from the use of that product has built a dependence on a feature that has nothing to do with the firm or its activities.

This observation creates an interesting paradox for BoP business models. Our research findings suggest that ventures will be more likely to succeed in the BoP if they adapt their business models to incorporate the context of their intended markets. Because context includes complex pre-existing systems like social networks and mental models, these entrepreneurs are intentionally designing business models that require the entrepreneur to relinquish control over the activities of firm. In turn, the ensuing performance of the venture is less easily traced to the choices of the entrepreneur.

This may cause some consequences of business model decisions to inadvertently seem insensitive to the preceding choice and thus, in the words of Casadesus-Masanell and Ricart (2010), “rigid”. As a result, the contextualized business model may more accurately explain and propel the success of ventures in the BoP, but it may not be useful as a discrete unit of analysis for evaluating decision-making in the BoP.

**Limitations and Further Research**

The sample from which we abduced this framework of a BoP business model has three important characteristics to consider in judging how far these findings and results can be extrapolated. First, despite the proliferation of new off-grid electricity projects in the BoP, one respondent attested that only 3% of the market for off-grid energy in the BoP has been served. Most of the ventures in our sample serve uncontested niches, reducing or even altogether avoiding intra-market competition. Second, all of the
entrepreneurs in our study reported that potential customers are already familiar with and desiring of electricity. There is very little need among these ventures to stimulate initial awareness or to demonstrate the basic value of the core offering. The demand for affordable, accessible electricity already exists. Third, as mentioned above, BoP markets lack infrastructure for transportation, mass communication, insurance, contract law, and a host of other market-organizing foundations that entrepreneurs in developed markets take for granted. These comprise the boundary conditions for this BoP framework.

With additional research, we contend that aspects of this framework could first be useful to explain and propel ventures in other sectors within the BoP, and then could be applied to competitive mature markets without preexisting demand. Specifically, the notion of embeddedness in BoP business models might be extended to assist managers of companies of any size in any market with building a more complete and detailed picture of their customer segments by delving into their social networks, activity cycles, mental models, and existing product constellations. Similarly, the emphasis on market linkage and the tactics of these BoP ventures to achieve affordability may provide interesting ideas for managers in mature markets to consider in constructing new business models in order to strengthen the long-term value of their firm and their partners. Although ventures in mature markets have ample access to distribution channels, the reliance on social networks in the BoP may offer managers in other markets insight into opportunities to make supply and distribution chains more efficient.

In general, the elements of business models that have been tested and proven in the undeveloped entrepreneurial environments of the BoP are worthwhile to consider for
export to business models of ventures in developed countries seeking to create and capture value in competitive markets.
REFERENCES


Paper presented at the Academy of Management Annual Conference, Vancouver, Canada.


