

What is a Pivot? Explaining When and How Entrepreneurial Firms Decide to Make Strategic Change and Pivot

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Abstract

Most theories of strategic change focus on how large, established firms invested in their existing capabilities either recognize or fail to recognize the need for strategic change. Little research examines how early stage entrepreneurs lacking such investments decide when and how to change their strategies. With a longitudinal field study of seven entrepreneurial firms developing innovations in energy and cleantech, we examined 93 strategic decisions at risk for change. We found that decision makers chose to change their strategy only when new information conflicted with or expanded their beliefs. A pivot, or a strategic reorientation, was not achieved with a single decision, but by incrementally exiting or adding strategy elements over time, accumulating into a pivot. We contribute a grounded definition of what constitutes a pivot and explain when and how entrepreneurial firms pivot.

Keywords: entrepreneurial firm strategy, innovation, strategic change, pivot, technology entrepreneurship

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Stewart Butterfield, the boss of Slack, a messaging company, has been wonderfully unlucky in certain ventures. In 2002 he and a band of colleagues created an online-video game called “Game Neverending”. It never took off, but the tools they used to design it turned into Flickr, the web’s first popular photo-sharing website. Yahoo bought it in 2005 for a reported \$35M. Four years later Mr. Butterfield tried to create another online game, called Glitch. It flopped as well. But Mr. Butterfield and his team developed an internal messaging system to collaborate on it, which became the basis for Slack. In Silicon Valley, such a change in strategy is called a “pivot”; anywhere else it is called good fortune. (Economist 2016)

Slack is a poster child for the term “pivot” – an innovative entrepreneurial technology firm founded to build one product but, after that failed, changed its product, collected \$540M in funding, and achieved a valuation of \$3.8B and counting (Economist 2016). With examples like these, it is no wonder that entrepreneurs have embraced the “pivot” as a strategic action that leverages a firm’s technology innovations, adapts them for new markets, and enables the firm to survive, like a phoenix from the ashes. The term “pivot” entered the entrepreneurial lexicon and the business school classroom with the Lean Startup methodology and the work of entrepreneur practitioner authors such as Eric Reis and Steve Blank (Reis 2011, Blank 2013). In their eyes, a pivot is a substantial change made after customer feedback violates a firm’s business hypotheses.

Entrepreneurs and the popular press have embraced the term “pivot”, to describe nearly any strategic shift made by a firm, a person, or even a government¹. The few scholars that have studied entrepreneurial pivots (McDonald and Gao 2016, Leatherbee and Katila 2018, Grimes Forthcoming) have not elaborated on this definition, and the emerging conversation has unfolded largely detached from a long tradition of scholarship on strategic change.

One reason for this disconnect is that this literature does not necessarily speak to entrepreneurial firms – strategy scholars have traditionally devoted their attention to how mature firms with substantial investments in their existing capabilities, structures and markets make strategic

¹ An online search for the term “pivot” of business magazines and newspapers such as Forbes, Inc., The Economist, and The New York Times returns article titles such as: “Millennial News Site Mic Lays Off 25 Employees In 'Pivot' To Video” “Pivots Are For Leadership -- Not Just Strategy” “Republicans Pivot and Make Comey the Capitol's Most-Wanted Man” “7 Signs You Are Ready For A Work-Life Pivot”

change to refresh or renew established strategies (Rajagopalan and Spreitzer 1997, Agarwal and Helfat 2009, Williams, Chen et al. 2017). Less attention has been paid to how entrepreneurial firms hone or make changes to nascent strategies. Existing theory suggests that mature firms are motivated to make a strategic change when they perceive a performance gap between their target and expected performance (Cyert and March 1963, Levitt and March 1988), often after a long history of past performance. Entrepreneurial firms may confront the decision of whether to change their strategy without extensive firm history and may need to make sense of either thin or ambiguous data (e.g. Joseph and Gaba 2015). As Cohen et al note: “[N]ew ventures have little or no historical performance and often lack a suitable industry peer group, making it difficult to know where to set aspiration levels” (2018: 4).

How firms either do or do not change their strategies is often examined in response to the introduction of technological innovations developed by others (Henderson 1993, Christensen 1997, Tripsas 1997, Tripsas and Gavetti 2000, Gilbert 2005) rather than from endogenous sources of information gleaned from experimentation or learning. How firms in the process of developing technology innovations decide to change their strategies as they develop novel technologies is less understood. Developing new innovations in any context is “thoroughly infused with uncertainty” (Coase and Wang 2011), and entrepreneurial firms developing novel technologies frequently encounter previously unknown technology constraints that alter what the firm can build and market with the resources available. When entrepreneurial firms engage in strategy formation (e.g. Ott et al 2017) there is often awareness that their strategies include untested beliefs that could prove to be inaccurate. Packard, Clark et al. (2017) consider this to be “absolute uncertainty” where entrepreneurs face unlimited options and the “possible outcomes are unknown and unknowable” (2017: 845). Under these conditions, establishing a gap between target and expected performance may be less relevant to explaining entrepreneurial strategy change, but little theory explicates what

triggers entrepreneurial firms, engaged in innovation, to change their strategies. When and how do entrepreneurial firms decide to make strategic change?

To address this gap, theories of strategic change need to explain how change decisions are made when entrepreneurial firms are engaged in the process of developing new innovations – when they may be prompted to process new information and make strategy decisions before comparable performance targets can be established. Entrepreneurs like Butterfield, frequently encounter new information that may trigger them to consider strategic change prior to receiving feedback on the firm’s performance. Unfortunately, when and how entrepreneurial strategies change at a nascent stage are rarely captured in commonly available datasets and are less accessible for scholars to study (Aldrich and Yang 2012). With a longitudinal field study of seven early stage energy and cleantech hardware firms developing new technology innovations, we examined when and how entrepreneurial decision makers decided to make strategic change. Over a one to three year period, we interviewed and observed founders and team members regarding decisions that affected the fundamental definition and core processes of their firms to obtain a collected set of strategic decisions at risk for change. Rather than select on strategic change, this approach permitted equitable treatment of the decision to either select or reject strategic change.

From our analysis of 93 strategic decisions at risk for change, pooled from the seven firms studied, we found that, in contrast with the notion of pivots as “swift change” (Leatherbee and Katila 2018), firms in our sample rarely pivoted. When a firm made a decision to change their strategy, they chose to either exit or add an element to their strategy rather than to completely reorient the firm’s strategic direction. On their own, these types of strategic change decisions did not produce the type of “pivot” Mr. Butterfield accomplished when he transitioned his firm from the video game Glitch to the internal messaging application Slack. Drawing from our data and the literature on strategic change (Gioia, Thomas et al. 1994, Van de Ven and Poole 1995, Rajagopalan

and Spreitzer 1997, Agarwal and Helfat 2009), we define a pivot as a change in a firm's strategy that reorients the firm's strategic direction through a reallocation or restructuring of activities, resources, and attention. With this definition, we are agnostic about whether the change is in technology, product or market (e.g. Furr, Cavarretta et al. 2012) but argue that pivots require a reorientation of the firm's strategic direction supported by resource commitments. Ultimately, three out of seven firms studied experienced a pivot during our multiyear study. Rather than make a single decision to pivot their strategy, firms that pivoted made several decisions that cumulatively reoriented the firm's strategic direction. Revisiting each firm's case, we identify a grounded theoretical model to explain the conditions under which entrepreneurial firms developing technology innovations pivot. In doing so, we contribute an explanation of strategic change and strategic reorientations (or pivots) that take the emergent entrepreneurial process of innovation into account.

Strategic Change and Innovation

Strategic change and strategic renewal are often used interchangeably in the literature (Rajagopalan and Spreitzer 1997) but most often scholars refer to strategic renewal as "the process, content and outcome of refreshment or replacement of attributes of an organization that have the potential to substantially affect its long-term prospects" (Agarwal and Helfat 2009: 282). Research on strategic renewal typically examines what drives or inhibits mature firms from renewing their strategies in response to shifts in their industry and environment (e.g. Dutton and Duncan 1987, Zajac and Kraatz 1993, Kaplan 2008). While offering robust explanations for the rigidities, cognitive barriers, and biases that plague mature firms from adopting or executing on strategic changes in a timely fashion (e.g. Barr, Stimpert et al. 1992, Henderson 1993, Tripsas and Gavetti 2000, Eggers and Park 2018), our current understanding of strategic change in entrepreneurial firms faces three limitations.

First, the strategic change literature theorizes that firms are motivated to change when new information illuminates a gap between a firm's target outcome and its expected performance (Cyert

and March 1963, Levitt and March 1988) regardless of whether this gap is aspirational, identifying an opportunity for improvement, or negative, forewarning plunging revenues. However, firms can amass volumes of data that illicit conflicting interpretations (Daft and Weick 1984, Maitlis and Christianson 2014), and thus such comparisons may not be so cleanly determined. Recently, Joseph and Gaba (2015) showed that when performance feedback was ambiguous, inconsistent across multiple sources, decision making and action was delayed as firms made sense of information. Identifying clear, concrete outcomes to compare a firm's performance in relation to its business environment is not easily done for any firm, but this is particularly true for entrepreneurial firms that lack a long history of performance to form a basis for comparison.

Second, examination of strategic change tends to equate change as positive, often assuming that strategic renewal was the correct and necessary decision, rather than evaluating what prompted decision makers to select or reject change contemporaneously. For example, Barr, Stimpert et al. (1992) define the opposite of strategic renewal as strategic decline. This perspective views strategic change as the appropriate reaction to a firm's environment: "a difference in the form, quality, or state over time (Van de Ven and Poole 1995) in an organization's alignment with its external environment" (Rajagopalan and Spreitzer 1997: 49). Operating with the benefit of hindsight, it is easy to assume that strategic change was the correct choice for the firm at the time and then to examine how firms failed to perceive or act on this information (e.g. Christensen and Bower 1996, Christensen 1997). Evaluating the drivers of strategic change contemporaneously is a more difficult task. Furthermore, what prompts strategic change for early stage entrepreneurs may be challenging given the untested nature of entrepreneurs' still formative strategies (McMullen 2015).

Third, the focus within the strategic change and renewal literature has been on mature and established firms' reaction to exogenous shifts (Dutton and Duncan 1987) such as changes in regulations (e.g. Barr 1998); technology (e.g. Christensen 1997, Tripsas 1997, Gilbert 2005); or

market preferences (e.g. Zajac and Kraatz 1993). For example, studies have examined why a focal firm did or did not change its strategy in the face of new innovations made by competitors (e.g. Bower and Christensen 1995, Tripsas 1997, Gilbert 2005). While important for understanding the triggers for strategic renewal in mature firms, this research does not explain how firms developing new innovations make decisions about strategic change. When developing new innovations, both entrepreneurial and mature firms engage in experimentation and hypothesis testing (Thomke 1997), where new discoveries may prompt consideration of strategic change prior to obtaining information on firm performance. In this context, the choice to change strategy may not be a reaction to the innovations of others, but triggered by emerging discoveries revealed during a firm's own innovation process. For example, after Raytheon engineer Perry Spencer figured out why candy bars melted in his pocket while he worked with the microwave magnetron, Raytheon expanded its strategy of being a WWII era military electronics supplier to create a civilian food appliance division, introducing microwave popcorn to the world (Ackerman 2016).

In short, research on strategic change tends to evaluate how established firms respond to innovations introduced by other firms rather than examine how entrepreneurial firms respond to opportunities for strategic change that emerge when developing new innovations. The study of established firms reacting to exogenous change starts from the position of mature firms that have already achieved strategic alignment with their environment and have a track record of performance. When and how strategic change happens at entrepreneurial firms, whose strategies are formed, (Ott, Eisenhardt et al. 2017) but untested, is less understood. Entrepreneurial firms in the process of developing novel innovations, face many uncertainties as they transition from ideas to concepts to marketable products and services (e.g. Packard, Clark et al. 2017). Firms pursuing a 'strategizing by doing' approach act with the explicit intent to learn and change their strategies as experience fills in what could not have been known in advance (Ott, Eisenhardt et al. 2017). Firms pursuing a

‘strategizing by thinking’ approach use mental models and analogies as proxies for ambiguous or uncertain information about their futures, still aware that those cognitive tools may need to be revised as the future unfolds (Ott, Eisenhardt et al. 2017). As new information is revealed, firms may update not only their beliefs and assumptions, but also their strategies, well in advance of achieving strategic alignment or perceiving a performance gap.

Fundamentally, the challenge for entrepreneurial firms deciding when to change their strategy is not about renewing a tested and previously successful strategy, but about whether and how to change a strategy that is formed (e.g. Ott, Eisenhardt et al. 2017) but untested. In other words, in this phase of strategy evolution, entrepreneurs have crafted a strategy and have begun to enact it by allocating and structuring activities, resources and attention. They are discovering which elements of this strategy will work. For example, if an entrepreneur discovers, through engagement with potential customers, that a particular innovation will perform better as an enterprise product than a consumer product, this discovery may prompt the entrepreneur to question the planned strategy. As entrepreneurial firms engage in the process of commercializing new technologies, they will experiment and test both product and market hypotheses that will not all be confirmed and, through this process, identify new information that may trigger consideration of strategy change. Understanding this granular process is not easy as the artifacts and measures traditionally used to examine when and how established firms make strategic changes, such as annual reports, budget breakdowns, and the creation of new formal roles and titles (e.g. Romanelli and Tushman 1994, Kaplan 2008) may not yet exist or be publicly available. To examine when and how early stage entrepreneurial firms developing new technology innovations decide to make strategic change, what is needed is contemporaneous examination of the stream of decisions made by entrepreneurial firms (Mintzberg 1978) in their earliest stages of enacting a strategy, once formed. Rather than selecting on strategic change, what is needed is an approach that identifies strategic decisions at risk for change in

order to treat the possibility of stasis and change equally and trace how strategies evolve (Mintzberg and Waters 1985). Only by doing so can we develop an understanding of the conditions that prompt decision makers to either select or reject strategic change.

Research Methods

Qualitative field methods are appropriate for this study as they allow for in depth investigation of a phenomenon whose boundaries are not clearly evident in advance (Langley 1999, Eisenhardt and Graebner 2007, Bettis, Gambardella et al. 2015). Longitudinal, real-time field research can provide a collected set of choices managers face without ex ante filtering (Van de Ven 1992). Thus, we used a longitudinal, qualitative field study to examine the antecedents or triggers to strategic decisions at seven early stage entrepreneurial firms developing hardware in the energy and cleantech sector. We investigated the events that prompted strategic decision making and traced when decision makers selected or rejected strategic change. We probed entrepreneurs and their teams about recent and under consideration strategic decisions that informants deemed to be “impactful” to the strategy of the firm. By examining the decision making process for a collected set of decisions at risk for strategic change, we identified when firms considered and rejected strategic change as well as when firms opted to change their strategy. We then analyzed the types of strategic change selected by each firm to understand the conditions that produced a pivot or strategic reorientation.

Research setting: energy & cleantech hardware

We selected seven entrepreneurial firms pioneering new hardware technology in the energy & cleantech sector as this is a sector fraught with uncertainty that can affect firm strategy in its earliest stages. New entrants aim to either replace existing technologies, supplant mature firms, or create new product categories. While developing their novel technology products, pioneering firms cannot know in advance which innovations will be preferred by the market (Grodal, Gotsopoulos et al.

2015). Energy and cleantech technologies often require significant capital and long development cycles which can be extended by industry regulation or politics (e.g. Guo 2014). Recent high profile failures involving federal loans have hurt the reputation of the sector in the eyes of investors and decreased their willingness to participate (Mowery, Nelson et al. 2010, Hargadon and Kenney 2012), increasing uncertainty as to whether funding will be available to reach the next milestone (e.g. Gompers 1995). All firms in this context face heightened uncertainty as new information about technology, regulations, and available financial resources throughout the sector are subject to constant change.

Theoretically driven sample design

We employed a theoretical rather than representative sampling by selecting entrepreneurial firms based on characteristics that provide the opportunity to extend relationships and logic among constructs (Eisenhardt and Graebner 2007). Entrepreneurial hardware firms were theoretically desirable as they are understudied relative to software firms. A benefit of selecting hardware firms is that the decision to change strategy will be explicit and observable to the researcher. While software developers can instantly identify whether the code developed will compile to create a coherent build, tracing these moments can be difficult for a researcher. In the case of hardware, it will be very clear to the researcher if lab tests or prototypes function as intended. Firms were selected into the sample based on two criteria. First, we chose firms that were pre-sales at the time of entry into the study as sales represent a contractual commitment in a product's form, features, market, pricing, and supply chain that are difficult to reverse. By selecting entrepreneurial hardware firms prior to committing to customers, we were able to gauge entrepreneurial strategy in a nascent stage, increasing the opportunity to observe strategic shifts (Ott, Eisenhardt et al. 2017).

Second, each firm employed at least three people at the time of entry into the study. Additional staff commit the founder to the firm's success and serve as an indicator that the

entrepreneur has escalated from a lone inventor to a business venture, since additional team members require organizational structure and resources. From the researcher's perspective, teams of three or more members provide more varied vantages into the strategy decision making process as their presence requires the founding entrepreneur to articulate strategic goals and decisions explicitly to the team. The seven firm sample was compiled through introductions made by the researchers' university network of entrepreneurs. All firms were located in the Boston metropolitan area at the time of entry to the study. Founders were approached by email or in person and asked to participate in a field based research study on how entrepreneurial firms in nascent technology industries navigate strategic change. Additionally, they were told that each firm would be kept unidentifiable in presentation and publication of the research. To this end, all firm and informant names presented are pseudonyms and details about the technologies and products under development are disguised.

All seven firms were founded to commercialize a novel technology hardware and create a new market or replace an existing technology. This sample of firms founded between 2007 and 2013 includes a variety of technologies within the energy and cleantech sector such as power generation and storage (Coulomb, Farad, Gauss); energy efficiency improvements of electrical systems (Joule, Ohm); and pollution (Ergon, Hartree). All firm founders had educations and backgrounds in engineering: three with prior startup experience and four recently graduated students. Table 1 provides an overview of the firms at entry to this study.

----- Insert Table 1 about here. -----

Data collection

The first author conducted 82 semi-structured interviews during which founders and team members detailed strategic decisions that affected the firm's strategy. We interviewed founding entrepreneurs, the top management team, board members, engineers, investors, and other advisors involved in strategic decisions at each firm. Introductory interviews began with the informant generating a list of

strategic decisions impactful for the firm. We consider strategic decisions to be related “to the long-term prospects of the company” and have a “critical influence on its success or failure” (Agarwal and Helfat 2009: 281). During initial interviews, informants were asked to discuss as many impactful strategic decisions as time allowed. Follow-up interviews explored how previously identified strategic decisions evolved as well as new strategic decisions that had since emerged. Interviews averaged 70 minutes in length and all interviews were recorded and transcribed.

Interviews were conducted over a one to three-year period (depending on firm entry to the study) to capture the evolution of firm strategy while decisions and recollections were contemporary. Firms entered the study at different times between the second quarter of 2012 and the first quarter of 2015. Two firms (Gauss and Ohm) entered the study a year earlier than the other firms as a pilot to test the research design. Figure 1 shows how these data were distributed by type of information at each firm over time. We augmented interview data with 48 onsite observations coinciding with interviews held at the firms’ offices and 69 internal and external documents, including board presentations, articles about the firms and the founders, and stakeholder communications provided by informants to confirm the timing of key events.

----- Insert Figure 1 about here. -----

Data analysis

Data analysis was a six phase inductive and iterative theory building process. In the first phase, we identified 147 strategic decisions from the interview data pooled across all seven firms. For example, in several interviews, informants from Coulomb discussed whether to target venture capital investment. We coded this as one strategic decision. Since our goal was to examine strategic decisions at risk for change, rather than strategy formation, we excluded 46 decisions discussed during interviews that were made as part of founding the firm and forming the initial strategy, which could therefore not be considered at risk for change. Each firm had formed a strategy prior to entry

into this study, but decisions made during strategy formation of strategy were not included in the data analyzed. Of the 101 strategic decisions for which change was considered, 93 were completed at the conclusion of data collection. These 93 strategic decisions across the seven firms constitute the pooled data set for this study and represented a collected set of strategic decisions at risk for strategic change.

In the second phase, we used open coding to identify what stimulated (Mintzberg, Raisinghani et al. 1976) or triggered strategic decision making. Drawing upon Sonenshein (2009), we identified triggers as information that prompted a new strategy question and catalyzed firm decision makers to consider strategic change. Increasingly, scholars recognize that sensemaking is critical to managers' recognition of the need for strategic change (Barr, Stimpert et al. 1992, Gioia and Thomas 1996, Kaplan 2008). In our case, triggers stimulated decision makers to question the firm's current strategy and consider the possibility of strategy change. To account for varying perspectives, we coded triggers three ways. First, we coded triggers by the nature of the information introduced to the decision maker, such as technology, market, financing, supply chain, or organizational activities. Second, inspired by Gersick (1988) and Kaplan and Orlikowski (2013), we coded triggers temporally by development phase or milestone, capturing when triggers to a decision appeared during the innovation process. Third, drawing on research about the antecedents (Fiss and Zajac 2006) or catalysts of strategic change (Jackson and Dutton 1988, Gilbert 2005), we coded whether triggers presented either a problem or an opportunity, from the shared viewpoint of the firm's decision makers. A problem trigger introduced information that posed a potential loss or unfavorable impact to the firm that could decrease the firm's value or increase the likelihood of failure. An opportunity trigger introduced information with the potential for gain or a favorable impact that could increase the value of the firm, its products, or its chances of success. We did not identify cases where entrepreneurial teams disagreed as whether a trigger presented a problem or an opportunity.

In the third phase, we coded how decision makers confronted the strategy question posed by the new information which triggered decision making and whether decision makers decided to change their firm's strategy for each of the 93 completed decisions. For each strategic decision, we identified the strategy question prompted by the trigger as well as the options under consideration by the decision makers. A decision was coded as at risk for strategic change when at least one option under consideration involved strategic change. Unlike definitions of strategic renewal (Barr, Stimpert et al. 1992), we did not assume a priori whether strategic change was necessary. Rather, we coded a decision to make a strategic change as a decision maker's explicit choice to deviate from the firm's existing strategy without judgement by the researcher as to whether change was needed. Following Romanelli and Tushman (1994); Boeker (1997), and Cui, Calantone et al. (2011), we operationalized a strategic change as a decision to change at least one element of a firm's existing strategy (e.g. a change in product line, market breadth, or partnering strategy). We considered firms to reject strategic change if they made no adjustment to their allocation or structure of their existing activities, resources, and attention (e.g. Ocasio 1997) or made only slight adjustments to reinforce their current strategy.

To understand not just when firms made strategic change but how firms changed their strategies, we coded the 21 strategic change choices made and identified two types: strategic exits and strategic additions. A strategic exit occurred when a firm chose to discontinue a current product without replacement. For example, after realizing they could not fit their prototype into its required packaging, let alone the suitcase the CEO was taking to the industry's annual convention, Joule gave up on that market and cancelled their only product, leaving the firm with a hole in their strategy. As this study took place before customer commitments were in place, exiting a product incurred only one strategic change without concomitant changes in other areas. A strategic addition occurred when a firm added a new value proposition or set of activities not previously included in the

strategy. For example, Hartree unexpectedly acquired their only competitor when this firm lost its investors, adding new designs to Hartree's product portfolio before Hartree's own products were ready for commercial production. Six out of seven firms chose strategic additions and three out of seven firms selected strategic exits during the time of study. Only one firm, Ergon, made no strategic changes.

In the fourth phase, we mapped different types of triggers with strategic decisions. We used tables (Miles and Huberman 1994) to identify patterns between decision triggers and strategic decisions. We found no patterns based on the content (technical, market, financing, etc.) or the timing of decision triggers. Ultimately, we did find a pattern based on the favorability of decision triggers. To better understand this pattern, we returned to the data in a fifth phase and examined the collected set of strategy options and the statements made by decision makers about the information and beliefs they considered during each firm's strategic decision making process. We defined a belief as an assertion or conviction that an uncertain or unverified statement is or will be true (McMullen and Shepherd 2006). When decision makers selected a strategic exit, they stated how the trigger's new information conflicted with one or more of their beliefs about the uncertainty the firm faced. When decision makers chose a strategic addition, they restated their beliefs about the uncertainty the firm faced, but updated those beliefs using broader language encompassing a more expansive strategy.

Following the logic of Mintzberg (1978), in the sixth and final phase of analysis, we traced each firm's strategy through their pattern of strategic decisions by creating timelines of each firm's decisions. While the Lean Startup methodology equates the term pivot to any change made in response to a strategic validation test (Ries 2011, Blank 2013), the strategic additions and exits we observed, on their own, did not constitute a pivot or strategic reorientation. Revisiting the literature on strategic change (Gioia, Thomas et al. 1994, Van de Ven and Poole 1995, Rajagopalan and

Spreitzer 1997, Agarwal and Helfat 2009), we defined a pivot as a change in a firm's strategy that reorients the firm's strategic direction through a reallocation or restructuring of activities, resources, and attention. By mapping the patterns of strategy exits and additions, we developed a grounded explanation of how strategy decisions either did or did not accumulate into a strategic reorientation or pivot over the period of study. From this analysis, we contribute a theoretical framework to explain when and how entrepreneurial firms make strategy changes that produce pivots.

When Firms Decide To Change Their Strategy

When confronted with information triggers that prompted a new strategy question, decision makers considered strategic change. All firms experienced two types of triggers during the time of study: problems and opportunities. Most often, decision makers retained their beliefs without altering their strategy and rejected the option to make a strategic change. Only about one fifth of the time did decision makers enact a strategic change. When decision makers chose strategic change, they either found their beliefs in conflict with a problem trigger and chose a strategic exit or embraced an opportunity trigger, expanded their beliefs, and chose a strategic addition. Despite the fact that six out of seven firms chose to make a strategic change at least once during the period of study, only three firms ultimately pivoted, changing their prior strategic direction by reallocating and restructuring their activities, resources, and attention. However, a pivot did not occur as the product of one strategic change decision. When firm decision makers chose to make a strategic change, they changed an element of their strategy but not the overall strategy. When pivots occurred, they unfolded over the period of study through accumulation of a series of independently triggered strategic decisions.

When is a firm's strategy at risk for change?

As might be expected with entrepreneurial firms developing new technical innovations, the firms in our study continuously identified new information about their technology, market, financing, or

industry. When the team encountered information that aligned with or confirmed their expectations, the firm continued with its activities unaffected. When information diverged from or challenged their beliefs about their firm, technology, or strategy, decision makers were prompted to ask a new strategy question in which they considered whether to change their strategy. In these moments, the firm's strategy became at risk for change.

Content of Trigger. Triggers to strategic decision making varied in the content of their information; in their temporal relationship to the firm's activities; and in the favorability of the potential impact to the firm, as seen in Table 2. Some firms experienced more triggers than others, but because they were all working on different technologies and were at different stages of development, we cannot draw conclusions from these differences in frequency. A trigger's content could refer to a firm's technology, such as when Joule's prototype literally exploded on the lab bench and prompted the team to question whether they should continue developing that product. Additionally, a trigger's content could refer to a firm's target market, such as when Ergon was invited by a potential partner to begin sales in a new nation, prompting Ergon's CEO to question whether and when they should expand internationally. A trigger's content most commonly related to financial needs or potential funding sources, such as when Ohm's low bank balance prompted the board to question whether the firm should take on venture debt. Triggers could also stem from organizational activities such as when a miscommunication within Gauss' leadership triggered a question about quarterly and annual personnel and firm target metrics. Finally, new supply chain information could also trigger strategic decisions such as when Coulomb's conversations with potential investors from across their industry prompted the team to question where in the industry's value chain Coulomb should position itself.

----- Insert Table 2 about here. -----

Timing of Trigger. Triggers emerged at different points in time and could affect strategic

decision making in multiple ways. For example, information was often identified as a deadline approached or as the firm prepared to transition into a new phase of development. As Farad's need for funding stretched on, potential investors expressed that they would like to see a working small scale prototype. This triggered Farad to question whether to reconsider its strategy not to waste time or resources building "a toy" prototype. As Coulomb prepared to transition from component development to building their scale prototype, information about the ceiling heights of local commercial properties triggered the team to question whether they should relocate the firm to a different state. Prior decisions could also produce new information that triggered new decisions. For example, Joule decided to redesign their product. This redesign introduced new features that triggered the team to question whether they should target a B2B customer rather than a consumer as their first market.

Favorability of Trigger. From the perspective of our informants, the information presented by a trigger could pose either a problem or an opportunity for the firm's current strategy. A problem trigger introduced information that posed an unfavorable potential impact to the firm, with the possibility to decrease the firm's value or resources or to increase the likelihood of failure. For example, an industry engineer talking with Joule's R&D team at a conference booth educated the team about how their target market makes purchase decisions based on one performance indicator: the one Joule's product lagged by a factor of 1,000. As the engineer walked away, Joule's R&D team asked themselves a new strategy question the team had not previously considered: could Joule still serve this industry customer given their underperformance on a valued dimension?

An opportunity trigger introduced information with the potential for a favorable impact that could increase the value of the firm, its product, or its chances of success. For example, when Ergon's CEO discovered that their machine would always be connected to the internet, he realized that Ergon could collect "big data" about their customer and monetize it, if they developed their

own software. Ergon's CEO then began questioning whether to develop their own software or rely on their manufacturing partner's pre-existing software tools, as originally planned.

All firms experienced both problems and opportunities during the time of study, as seen in Table 3. Many of the strategy questions prompted by these triggers asked specifically whether the firm should change its strategy, as with Joule's unfortunate conference booth conversation with the industry engineer. However, the questions triggered by these problems and opportunities were not inherently about strategic change. For example, when Ergon identified that their fundraising activities had exhausted all of the U.S. based Angels funding in cleantech, their problem prompted the team to ask where else they should look for funding. In their ensuing strategic decision process, Ergon's team considered other equity funding sources, Angels in other countries, grant programs, and pre-sale revenue, among other options, some of which would require reallocation and restructuring of their activities, resources, and attention while others did not. All firms experienced on-going triggers that prompted decision makers to question their strategy and engage in decision making. But not all firms made changes to their strategies when encountering a trigger.

----- Insert Table 3 about here. -----

When do firms choose strategic change?

When information triggers prompted decision makers to question their strategy, they considered strategic change as an option, but they did not necessarily chose strategic change. By examining a set of strategic decisions at risk for change, we were able to determine when firms chose to either select or reject strategic change. While firms considered strategic change as an option in each of the 93 decisions examined, predominantly, decision makers chose not to change their strategy, as seen in Table 4. In 72 decisions, decision makers maintained their beliefs about their firm, technology, and strategy and rejected the option to change despite the new information the trigger presented. In 21 decisions, when firms experienced a trigger that conflicted with or altered their beliefs, they chose a

strategy change.

----- Insert Table 4 about here. -----

Rejecting strategic change

Even when confronting triggers that challenged their beliefs about their firm's strategy, most of the time decision makers at all seven firms chose not to change their strategy (72/93). We considered firms to have rejected strategic change when they made no or only very small adjustment to their strategy after considering change. Firms rejected change when experiencing every type of trigger. For example, as Ohm transitioned between developing prototypes and developing a manufacturable product for their first B2B customer, the R&D team identified a technology problem: their current system architecture could not meet some of their customer's stated requirements. Ohm questioned whether to change their product features or their market strategy, but then rejected those options, instead focusing on a technology design that allowed them to appease their customer and continue the product launch order they believed optimal.

In some cases, when firms chose to reject strategic change, they accepted the potential negative impact the problem trigger presented. Ergon faced an impending supply chain deadline when they learned that Henry, their US manufacturing and distribution partner, had not begun the integration work necessary to sell their product. CEO Tad David questioned whether to wait, find a different partner, or build manufacturing and distribution capability internally. Waiting could mean months without sales or progress, effectively making the firm subordinate to Henry. While an alternative partner might reach the market sooner, no competitor had Henry's technological or market knowledge and reputation, and Ergon's current team had no manufacturing and distribution capabilities. None of their options were appealing. But, David continued to believe that partnerships provided speed and savings, and decided that waiting for Henry was the best choice regardless of the delay this posed for Ergon. As David stated:

We always tell ourselves we have the option to transition in-house down the road if we want to. We still say that to ourselves. I'd be hard-stretched to imagine a situation where we'd want to do that. You would only want to bring in-house something where you have a differentiating core competency. If a subcontractor can do it anyway then what's the point of me replicating that in-house? What strategic advantage does that give me?

While Ergon's team claimed to be open to strategic change, they continued to believe that partnering was optimal and chose to wait for Henry even if it meant temporarily shutting their doors. After this decision, Ergon's management team identified how long they could wait before having to "hunker down, send all our employees home, or half of them home, and just preserve our cash." Luckily, Henry stepped up within a few months and Ergon was back on track.

While in some cases, firms whole-heartedly declined opportunities, in other cases, firms found ways to use an opportunity to retain and reinforce their current strategy without making strategic change. They maintained their prior beliefs but used the opportunity to improve the potential of the existing strategy. In 2014, a government agency announced a multi-million dollar technology grant tailored to Coulomb's product, but the grant required applicants to submit proposals with several partners collaborating across the value chain. CEO Jim Allen questioned whether the grant money was worth bringing other firms onto a development project that would give those firms partial ownership of Coulomb's unique intellectual property, or worse the chance to steal it. The Coulomb team believed that they would eventually need to work with other firms across the value chain; however, they also believed that they needed to keep their IP secure to retain the firm's value to potential investors. CEO Allen maintained both of these beliefs throughout his decision making process and ultimately arrived at a solution that rejected strategic change. Instead of submitting a grant proposal for technology development involving several partners, Allen proposed a "paper study" that would collate technical requirements across the value chain and detail the costs and savings to each firm:

This [grant] project is the detailed design of the [whole] operation – the reason we pulled in a bunch of partners. Right now, it's a technical economic exercise for everybody, but at the end

of the day, we want everyone to have written down their scope and the price they want to do it for, and have everyone else agree: “That sounds good, we can do that.”

With this solution, Allen decided against a change that would involve sharing IP development and instead used the grant to collect detailed information and market Coulomb’s new manufacturing process to potential customers and suppliers. With the new project definition, Allen reinforced Coulomb’s existing strategy, maintaining control over their intellectual property while acquiring partners to pursue the grant opportunity.

Choosing strategic change

Six out of seven firms chose strategic change, in 21 of the 93 strategic decisions at risk for change.

When the information triggering decision making conflicted with or expanded the beliefs held about the firm, their technology, or their strategy, decision makers opted to change some element of the firm’s strategy. For example, Ohm identified an opportunity trigger in 2012 when an internal development project revealed the potential for an additional product not previously considered.

When they founded the firm, Ohm’s engineering team believed that their technology could only be commercially manufactured as a microchip. After CTO Al Marcone grew concerned that their microchip would not be ready for customer and funder demonstrations by the deadline needed to support a new funding round, he built a non-microchip prototype from “discretes” (off the shelf electronic components). CEO Cam Fahey described how this new “discretes” prototype triggered the team to question whether to change their strategy and develop a second product for commercialization based on discretes rather than a microchip design:

Al said, “I think we might be able to take it to production in discretes.” The only reason he was able to be pretty confident about that is because we had built something in discretes in the form factor. We are trying to squeeze everything into the little tiny space. Prior to having this [working prototype], there were people on the team who thought it was impossible to make it out of discretes in the form factor.

When the team saw Marcone’s prototype in action, they realized a “discretes” product could be

manufactured with the same features, although at a higher cost. The Ohm team knew of a niche consumer product that could support the higher price and asked the new strategy question: should they start a second product before completing development on their first product?

Before the CTO built the discrete prototype, the Ohm team described their belief in their technology by saying: “our microchip technology is going to change the world.” While decision makers wrestled with whether to change their strategy by adding a second product using the discrete design, the team expanded their microchip belief and shifted their language from “our microchip technology” to “our core technology.” Their new language now encompassed a broader strategy that did not require microchips. With this expansion in their beliefs, Ohm’s decision makers opted to change the firm’s strategy by adding a second development program before completing their original, microchip product.

How do firms change their strategy?

The six firms that did choose to change their strategies chose to either exit or add a new element to the firm’s strategy rather than make a complete strategic reorientation, as seen in Table 5. The type of strategic change firms chose depended on the favorability of the new information that triggered decision making: strategic exits were only triggered by problems while strategic additions were only triggered by opportunities. We identified no patterns with respect to the content or timing of the trigger to strategic decision-making. In five out of 21 cases, when decision makers found their beliefs in conflict with a problem trigger, they chose to make a strategic exit, exiting one key element of their current strategy. In 16 out of 21 cases of strategic change, decision makers embraced an opportunity trigger, expanding the language previously used to describe their firm, technology, or strategy, and choosing to add an element to the current strategy.

----- Insert Table 5 about here. -----

Strategic exits

Firms chose a strategic exit only when confronted by a problem that conflicted with the beliefs underpinning their current strategy. For example, the Joule team's belief that their "portable" product was ready for initial sales and its "product reveal" was contradicted by the harsh truth that they could not fit it into the CEO's suitcase for the annual industry conference. In our sample of seven firms, three firms chose a strategic exit: Gauss, Joule, and Ohm, with Joule and Ohm each making two exits. In these five cases, decision makers accepted that the new information presented in a problem trigger conflicted with their beliefs about the firm and the current strategy and opted to make a strategic exit by discontinuing the product involved. In four of the five instances where firms chose a strategic exit, they went several weeks or months without a product defined in their strategy.

After accepting that a problem conflicted with their beliefs, Joule, Gauss, and Ohm each choose to discontinue their only products. After the head of business development at their ideal B2B customer told Gauss CEO Gail "we just don't care about [that product]", Gail understood this new information as conflicting with Gauss' belief that their product should be sold as a new part to a system already in the market. Gail questioned whether Gauss could continue with this product and subsequently decided to discontinue their only product without knowing what would replace it.

Joule's co-founders believed that with 3D printing, they could produce very low cost, "game changing" products with a short production cycle. In the spring of 2014, they impressed their dream customer who ordered 500 units to be delivered by October. Seven months later, the team and Joule engineer Sean Aalto realized that they would not be able to deliver on time and meet the expectations of their dream customer:

Everything was so tight to the point where if we don't talk to a manufacturer this week we're not going to make it. We went on for about two weeks just by the skin of somehow managing to do all the things that are absolutely necessary just in time where we still had maybe a little bit of belief that it could be done. All of a sudden, we didn't.

The news that manufacturing costs were rising and delivery would not be on time conflicted with

Joule's belief that their development process was low cost and fast. Joule's customer had a specific annual product cycle and October was the only delivery option until the following year. The team began to question whether they could deliver the product this year, and if not, could they survive until next year to deliver it then? In late August, CEO Oscar Mata decided to let their dream customer know they would not be able to deliver the order. Knowing that they could not sustain the firm financially if Joule had no other customers until the following October, Mata and his team decided to discontinue their only product and, as Mata described it, take a break:

What we decided to do was to take a one week content break, or a product break, and focus purely on operational structure and process. We reorganized our office space. We reorganized our prototype space. We redid the file management system. We redid the management structure and moved over to an Agile Scrum system... It was cathartic.

After their break, Mata went back to networking with investors and potential customers across several different markets to do more thorough customer research and select a new use case that could fill the hole in their strategy. In these cases, firms chose strategic exit without knowing what would fill the hole in their strategy.

Ohm also encountered problems that conflicted with their beliefs, and, in one case, was lucky to have a second product in place when they chose a strategic exit and discontinued their primary product. In 2013, Ohm had two products: 1) a microchip component to be sold first as a niche product and then as a mass market B2B product and 2) a non-microchip, non-component product to be sold in a secondary, direct to consumer market. Three years after founding, Ohm still did not know how much R&D time would be required to develop a manufacturable microchip design for the mass market product, and the management team demanded a revised development schedule from the engineers. When the engineers estimated that it would take another two years to produce, Ohm's CEO and CTO began to question whether they should even continue development on the mass market product. Launching their consumer product first conflicted with their belief that a mass market B2B product was the best way to introduce their new technology to the world, and

especially to future investors. CTO Marcone described how they chose a strategic exit:

I came to the conclusion that it didn't make sense to continue to invest in this other project unless it could be proven to some reasonable degree that there was a chance to make it work on a reasonable timeline. I didn't think that was going to happen. I also didn't see what else we could do...I don't remember exactly if I walked straight from [the timeline meeting] to [the CEO]. But in a very short period of time, yes, we started talking about it: "Look, this is crazy. Here's what they [engineers]'re telling me. It obviously doesn't make sense." She said, "Yes, it doesn't make sense. We already missed the market. We can't miss it by two more years."

Facing a two-year delay, Marcone accepted that the microchip product would not be the high volume, high visibility, mass market product Ohm believed would attract the next round of investors. Either Ohm could launch their non-microchip product in a lower visibility market or Ohm would run out of money and close its doors. Ohm decided to discontinue its microchip product even though this choice erased the high visibility product the firm had used to acquire funding so far. After this decision, Ohm still had one, low visibility non-microchip product, but now faced a significant hole in their strategy, losing the story that had been the basis for their fund raising pitch. Ohm would need to create a new fundraising narrative before their next funding round. When decision makers at the three firms making strategic exits encountered a problem that conflicted with their beliefs, they chose a strategic exit that left a gap in their strategy rather than fill this gap with a new, complete strategy. Having a strategy gap did not in itself trigger a subsequent strategic decision. In this case, the team continued to work on fund raising, technology and market development until new information triggered a new strategy question.

Strategic additions

Six firms chose to make a strategic addition when facing an unanticipated opportunity trigger, either adopting a new value proposition for their technology or adding new activities for the firm. When choosing a strategic addition, firm decision makers expanded the language they used to describe their beliefs and chose to add to their firms' strategy in ways that fit with this new language. For example, when Farad realized they could affordably get contract consulting from not only the co-

founder who had recently taken a day job but also others at his new firm, CEO Marek shifted from talking about maintaining their “A player” engineers by “keeping everybody in the fold” to “us be[ing] able to *use* [A player engineers]” who work elsewhere. The change in Marek’s language revealed the change in his beliefs about how Farad would tap into the best human capital. Marek decided to expand Farad’s strategy to include partner alliances rather than rely solely on internal engineering staff.

Five firms discovered new value propositions for their technologies either through continued technology development or through interactions with customers or partners. In the course of their technology development process, firms identified new use cases and target markets beyond what the founders had originally known about their technology and its potential applications. Potential partners, investors, suppliers, and other stakeholders engaged with several firms, introducing new ideas to expand the usage of their technology. On a long drive between customer sites, one potential customer introduced Gauss to a new use for their technology. As they chatted in the truck, this customer mentioned how a weather pattern brought the entire industry to a standstill for several days that year. Gauss’s consultant, David Baker, described how this casual conversation uncovered an unmet market need that provided Gauss with a new value proposition:

“How long did the [stoppage] last?” He said, “A good eight or ten days.” I said, “What do you do?” He said, “They had these [special products].”... I said, “Okay. Are there that many [of them] out here?” He said, “No. There’s a shortage of them.” [CEO Gail] says... “Well, not anymore.”

This customer revealed that there was a significant, motivated market for a product that could address this shortage with a high willingness to pay. Gauss’s engineering team considered the customer’s story alongside their knowledge that two-thirds of the design of their current product could be applied to solve this problem. After this conversation in the truck, the Gauss team expanded their beliefs about their technology, whereas before they spoke about their technology product, after this conversation they referred to their existing product as a system of three

“modules”. Their belief that their technology produced an innovative single product expanded in a belief about a technology platform of modules that could be reconfigured into multiple products. With their expanded belief, Gauss’ decision makers questioned whether they should take the first two modules of their three module “system” and create a new, two module product for this market. Having expanded the language used to describe their beliefs about the product, Gail and his team chose a strategic addition, adding a second product to the firm’s product portfolio based on the first two modules.

Opportunities did not only trigger product changes. In four cases, firms opted to add new elements to their organizational structure. Quite unexpectedly, four firms approached Hartree’s CEO Norman Beck and asked to be acquired. Beck had not planned to be “an uncaptialized company thinking about acquiring other companies that are sometimes many times our size.” Beck questioned whether any of these acquisition opportunities made sense and what those firms could add to Hartree. Since its founding Beck had described Hartree through its near-, mid-, and long-term products. Beck believed the firm “need[ed] three legs to every stool in order to maintain stability” and described the firm’s stability and future through the timeline of those three products. As he considered the question of acquisition, Beck shifted his language and began to talk about near- and long-term business: “What we have is the promise of long-term revenues and this big upside. What a lot of these companies don’t have is that. A lot of these companies have this on-going near-term business.” By expanding his beliefs about the stability and future of the firm from being about products to being about business, Beck now valued what the firm could gain from an acquisition: business assets such as direct customer knowledge, industry relationships, and financial inputs that Hartree did not yet have. With this change in language and beliefs, Beck decided to make a strategic addition and acquire one of the four firms.

As shown in Figure 2, firms encountered information triggers that prompted a new strategy

question with the potential for strategic change. When decision makers' beliefs were unaffected by a trigger, they rejected the option to change their strategy. When decision makers' beliefs were affected by a trigger, they revisited the beliefs underlying their strategy and chose to change their strategy. When decision makers' beliefs were affected by a problem, they accepted that the new information conflicted with their beliefs and chose a strategic exit without identifying a replacement strategy. When decision makers' beliefs were affected by an unanticipated opportunity, they expanded their beliefs and made a strategic addition, adding a new element to their strategy.

----- Insert Figure 2 about here. -----

In sum, we found that the type of strategic change selected depended on the relationship between the favorability of the information that triggered decision making and decision makers' beliefs about their firm's strategy. While some firms engaged in as few as three decisions at risk for strategic change (Farad), other firms engaged in this decision making process as many as 25 times (Joule) during the time of data collection – often working on multiple decisions simultaneously without knowing how all decisions in play would be resolved. By analyzing each firm's pattern of decision making over time, we assessed how and when decisions accumulated into a pivot and reorientation of the firms' strategy.

When Does Strategic Change Become a Pivot?

When entrepreneurial firms chose to change their strategy, they changed only one element in their strategy at a time, but this occurred within the context of multiple independently triggered decisions. They did not, in one decision, opt for a complete strategic reorientation through the reallocation or restructuring of activities, resources, and attention. Firm strategies evolved as decision makers made strategy exits and additions as triggers emerged throughout the innovation process rather than the product of planned, linear decision making. When firms chose to make a strategic exit, they left a significant hole in their strategy, which was left unaddressed until decision makers addressed a

separate opportunity trigger and opted to make a strategic addition that could address this gap. When firms chose to make a strategic addition, they did not inherently redefine the direction of the firm with one decision. Firms that pivoted did so through the gradual accumulation of multiple strategic decisions over time, rather than reorient the firm's strategy with one decision at once. While six of the seven firms in our study chose to make at least one strategic change, only three firms (Gauss, Ohm, Joule) pivoted and changed the direction of the firm. In our sample, all firms who pivoted made both strategic exits and additions, while non-pivoting firms only made additions. Figure 3 compares the stream of decisions in two firms that either did (Gauss) or did not (Coulomb) pivot to show how strategic decisions accumulated over time.

----- Insert Figure 3 about here. -----

We show how firms encountered an emerging stream of triggers that prompted questions, some of which produced strategic change, without necessarily producing a pivot. For example, Coulomb faced five opportunities and one problem that, cumulatively, triggered six decisions at risk for strategic change in the data collected from the firm's first six years. Although they made one strategic addition (to add a stepping stone product), the firm never pivoted. When Coulomb was founded, they were a manufacturing company developing a machine that would enact a new production process to improve efficiency in power generation and storage. Six years later, that still held true after considering and rejecting strategic change five times. For example, after several years of deliberation about their position in their value chain, Coulomb did not change their beliefs about how value could be captured in their industry and opted not to change their product strategy or position in the value chain. Coulomb also opted not to open a second office in Europe to take advantage of EU-based funding opportunities, but persisted in their grant-based funding strategy. They continued to believe that equity investors would not fund their product development and strategically scoped grant proposals to maintain complete ownership of their intellectual property,

which they believed to be their most important asset.

Coulomb did make one strategic addition: to add a “stepping stone product” but in doing so did not redirect the firm or its resources and produce a pivot. When a potential customer stated interest in a version of the machine that could be dropped-in to their current operations without the system-wide changes of Coulomb’s full innovation, CEO Jim Allen was prompted to question whether to change Coulomb’s product strategy and consider a portfolio of machines rather than only one model. While considering the question, Allen’s beliefs about the role of customers in the development process expanded, and he chose to make a strategic addition. Coulomb would create a drop-in version of their machine as “a stepping stone product,” a development prototype that would help them earn revenue as they gained customer feedback and technical data. While the strategic addition decision did change Coulomb’s product strategy, it did not change the firm’s strategic direction. Instead, it reinforced it in several ways. First, it helped customers gain trust with their technology with investing in large scale system change. Second, it helped Coulomb gain customer feedback earlier in their development process. Third, Coulomb could now earn revenue earlier to help fund further development. Thus, the “stepping stone product” strategic addition reinforced rather than reoriented Coulomb’s strategy. Firms like Coulomb made choices to change their strategy, not to pivot, but to stay the same and maintain their strategy.

In contrast, Gauss did pivot and reorient their strategy through an accumulation of eighteen strategic decisions including one strategic exit and six strategic additions, as depicted in Figure 3. Early on, Gauss discontinued their only product after learning that their ideal first customer had no willingness to pay for Gauss’s product. This strategic exit temporarily eliminated activities related to product development and the firm spent the next six months with a strategic gap and no defined product. During that time, the team continued developing its technology; acquiring funding and engaging in market research activities. Eventually, in a conversation with another entrepreneur,

Gauss's CEO learned about the maintenance and energy needs of a market they had not previously considered, prompting a strategy question that resulted in a strategic addition: a new product targeting a different market. While this new product altered some of Gauss's activities, a greater shift came two later when a conversation on a drive between customer sites triggered a separate decision at risk for strategic change. This time, Gauss expanded their beliefs about their product design as a platform for multiple technology solutions and decided to add a second product in what they now saw as a growing portfolio of services for their target market.

After seven strategic change decisions that produced one strategic exit and six additions, Gauss had pivoted from a product firm with one product that they planned to introduce across multiple markets into a technology services platform focused on a single market. In the firm's first blog post in 2013, they described themselves as a product firm building a "mass market" technology product with instructions "analogous to the ones found among IKEA furniture... A product that is good enough for most and great for those who really need what we want to make." After their accumulated stream of strategic decisions, their February 2015 post described how the firm provided a "solution built around [their core] technology" and since the technology was unusual to their target market they "offer training and certification programs that teach you how to integrate [it] in a variety of [one market's] products." Over three years and 18 strategy decisions, they had pivoted; they changed their strategy, their activities, resources, and attention.

A pivot is not a single decision to change the firm from one strategy to another, but rather the product of multiple independently triggered decisions that unfold over time. A firm pivots by reorienting the firm's strategic direction by exiting and adding elements to a strategy one at a time, eventually producing a cumulative reallocation or restructuring of activities, resources, and attention. Our informants never discussed a pivot in the present tense. They rarely used the term and only in the past tense to refer to a strategy transition in retrospect. For example, Ohm CEO Cam Fahey

used the term only a few times, each time talking about skills or resources that had been acquired, “then we pivoted” and they were no longer as valuable. This suggests that, for the entrepreneurial firms we studied, a change in strategic orientation was not the product of a single decision but rather a stream of accumulated decisions, punctuated by unanticipated triggers.

Discussion

Entrepreneurial firms developing novel technology innovations are often praised for having pivoted their strategies, but the term pivot is inconsistently defined and neglects the deep literature on strategic change. This may be because research on strategic change has examined strategic renewal and reorientation primarily in the context of established firms (Rajagopalan and Spreitzer 1997, Agarwal and Helfat 2009). Strategic change is theorized to result from a gap in performance (Cyert and March 1963, Levitt and March 1988), but there are some limitations in applying this explanation to early stage entrepreneurial firms. First, easily comparable discrete performance data is not always available or easily discernible (Joseph and Gaba 2015) and second, early stage entrepreneurial firms have yet to produce a trajectory of performance data to even allow such comparison. Third, extant explanations of strategic change are often reactive, focusing on why firms do or do not change in response to the innovations of others (Henderson 1993, Christensen 1997, Tripsas and Gavetti 2000), without understanding how decisions about strategic change emerge from a firm’s own innovation process. For example, Ohm did not know they could manufacture their technology without a microchip until the CTO built a prototype that convinced the team a non-microchip product was possible. Yet, research on strategic change does not explain when and how entrepreneurial firms engaged in the process of innovation decide to pivot their strategies. Without understanding how entrepreneurs receive and act on new information as they innovate, we cannot explain how strategies evolve at this this early stage. Through a longitudinal field study of seven early stage energy and cleantech hardware firms developing new technology innovations, we examined the

conditions that led entrepreneurs to select strategic change when confronting 93 strategic decisions at risk for change.

We found that when decision makers' beliefs were expanded by a favorable opportunity trigger, they chose to make a strategic addition, adding a new element to the firms' strategy. When decision makers' beliefs were contradicted by an unfavorable problem trigger, they chose to make a strategic exit, discontinuing the affected product. While all but one firm made strategic changes, these changes did not, necessarily produce a pivot or full reorientation of the firm's strategy. A pivot was not the product of a single strategic decision, but of the accumulation of independently triggered decisions that ultimately reoriented the firm over time. This understanding is more consistent with emergent rather than planned views of strategy (Mintzberg and Waters 1985). Drawing on the literature on strategic change and renewal (Gioia, Thomas et al. 1994, Van de Ven and Poole 1995, Rajagopalan and Spreitzer 1997, Agarwal and Helfat 2009), we offer a grounded definition of a pivot as a change in a firm's strategy that reorients the firm's strategic direction through a reallocation or restructuring of activities, resources, and attention. We found that three of the seven firms in our study achieved a pivot during the time of study and identify the conditions that did or did not produce a pivot. We contribute a grounded theoretical understanding of when entrepreneurial firms choose to change their strategy and when these changes produce a pivot, which is important to both the strategic change and entrepreneurship literatures.

When and how firms choose strategic change

Strategy scholars have examined when, in the face of environmental shifts, firms make or fail to make strategic change and renew their strategies (Rajagopalan and Spreitzer 1997, Agarwal and Helfat 2009). However, this research has been limited by a preoccupation with strategic change as the outcome of interest. In examining only those contexts where change is expected and not changing is a failure of either enactment or perception of the environment (e.g. Barr, Stimpert et al.

1992, Christensen 1997), the conditions under which a firm can reasonably reject strategic change are not typically considered. By identifying the triggers to decision making as well as the decisions at risk for change, we give equal attention to rejecting and selecting strategic change. Examining the collected set of decisions made, we find that the firms we studied rejected more often than they selected strategic change. Limitations of the data prevent us from addressing the role of cognitive bias in those cases in which the firms' beliefs were maintained without alteration. We studied entrepreneurs operating independently without the benefit of a structured program to prompt them to explicitly articulate or test their assumptions about their business model or strategy (Cohen, Bingham et al. , Leatherbee and Katila 2018, Grimes Forthcoming). Thus, our results may differ from settings where entrepreneurs are explicitly mentored to seek feedback from a broad network of external stakeholders and explicitly evaluate how new emerging information challenges their beliefs.

The entrepreneurial firms we studied faced significant uncertainty and relied upon beliefs about the firm, the technology and the market as placeholders for missing and uncertain information. They based their strategies upon those beliefs, knowing these beliefs could be revised at any time. As decision makers engaged in innovation, those beliefs were tested through a continuous stream of both favorable (opportunities) and unfavorable (problems) triggers that interrupted planned activities and punctuated strategic decision making. The firms we studied continuously engaged in validating or testing their ideas with customers, suppliers, partners and their own engineers which introduced new information that triggered multiple strategic decisions at risk for change. While Ott, Eisenhardt et al. (2017) distinguish between strategy by thinking and strategy by doing in entrepreneurial firms, we contribute an understanding of how strategy by thinking and doing unfold after strategy formation. Only by doing strategy could decision makers discover where their beliefs either conflicted with or could be expanded by an emerging stream of unanticipated opportunities and problems. When the beliefs that the firm's strategy rested upon were upheld,

decision makers rejected strategic change as the inputs to the original strategy were unchanged. When beliefs were altered by new information, the inputs decision makers relied upon for their strategy choices were altered, changing the basis of the original strategy and prompting strategic change.

While the focus of strategy research has traditionally been on established firms' reactions, or inactions, to environmental shifts (e.g. Dutton and Duncan 1987, Christensen 1997, Barr 1998, Gilbert 2005), we show how opportunities for strategic change emerge through the on-going process of developing new innovations. Firms developing new innovations face significant uncertainty (Coase and Wang 2011, Packard, Clark et al. 2017), and constantly encounter new information about both the potential and the limits of their innovations as the development process unfolds. These conditions likely apply not just to entrepreneurial firms but may be generalizable to other types of firms engaged in the process of innovation (Thomke 1997, MacCormack and Verganti 2003) or interacting with customers and partners. We identify the conditions under which innovating firms choose to change their strategy: when new information expands or conflicts with the beliefs underlying the firms' current strategy.

This study focused on the decision to make strategic change and did not address whether firms successfully executed their choice to change. There are two perspectives in the literature on whether favorable or unfavorable conditions catalyze strategic change. Jackson and Dutton (1988) found that firms were more likely to enact strategic change in response to problems or threats. However, Gilbert (2005) found that while threats were strong catalysts for the decision to change, firms needed to transition from a threat to an opportunity mindset to successfully execute change. In contrast with both of these findings, three quarters of the decisions to choose strategic change in our study were triggered by opportunities, not by threats. It is possible that the longitudinal nature of our data collection allowed us a vantage to identify opportunities to change that are not typically

observable in prior research designs. One way to reconcile our findings with Gilbert (2005) is to consider the unit of analysis. Gilbert observed a firm transition from a perceived threat that initiated strategic change to an opportunity mindset as a condition for successfully executing strategy change. Our research suggests an alternative interpretation: what he might have observed was a series of decisions; first involving a problem leading to a strategic exit, later followed by an opportunity with the problem leading to a strategic addition. Only after the completion of both decisions would Gilbert have observed a successful, firm level strategic change and reorientation.

What is a pivot? How firms make strategic reorientations

Colloquial use of the term pivot implies a single choice to pivot or reorient the firm's strategy. However, the Lean Startup methodology (Ries 2011, Blank 2013) considers a pivot to be a change to one element of the firm's strategy based on a hypothesis test, much as a scientist revises elements of scientific theory with the results of each scientific experiment. Building on the strategic change literature that discusses reorientation (Gioia, Thomas et al. 1994, Van de Ven and Poole 1995, Rajagopalan and Spreitzer 1997, Agarwal and Helfat 2009), we defined a pivot as a change in a firm's strategy that reorients the firm's strategic direction through a reallocation or restructuring of activities, resources, and attention. While almost all firms in our sample choose strategic change at least once during the study, only 3 out of 7 (Gauss, Joule, and Ohm) actually pivoted. Pivots were never accomplished with one decision but rather through the accumulation of a series of decisions to either exit or add elements to their strategy over time. One implication of this finding is that strategic change that reorients an entrepreneurial firm's strategy should not be examined as a single decision triggered by a single catalyzing event, but rather as a series of decisions triggered by a continuous flow of independently introduced information. Future research into strategic change should account for how research methods and data aggregation can obscure the separate decisions involved in strategic change. Our grounded explanation of how pivots do or do not happen aligns

more with the tenets of the Lean Strategy methodology, that entrepreneurs make a series of small changes to reach a tested strategy, than with the colloquial expectation that entrepreneurial firms pivot and “spin on a dime” repurposing a technology from one application to another.

Pivoting firms made both strategic additions and strategic exits; while firms that did not pivot (Coulomb, Farad, and Hartree) made only strategic additions. Future research should examine whether both additions and exits are necessary to produce a pivot. In firms that did not pivot, we observed decision makers considering strategic options that would have redirected firm strategy. For example, customers pushed back against Coulomb’s strategy to sell the output of their innovative manufacturing machine because they would prefer to buy the entire machine and operate it themselves. Had Coulomb’s decision makers expanded their beliefs about their firm and its position in the value chain, Coulomb could have made a strategic addition to become a producer of manufacturing machines rather than an on-demand supplier of a key component. While this would have produced a pivot for Coulomb, the triggering information did not expand their existing beliefs and trigger a choice for strategic change. Future research could examine what types of information are more likely to lead decision makers to expand their beliefs.

Identifying and assessing founding business opportunities are core topics within entrepreneurship research (Shane and Venkataraman 2000, Busenitz, West et al. 2003); however, the literature’s attention to opportunities tends to start and stop at firm founding (Shepherd, Williams et al. 2015). Beyond their initial founding opportunities, our firms faced an on-going stream of unanticipated opportunities after founding that triggered consideration of strategic change with the potential to reorient the firm's strategy. Our current understanding of entrepreneurship as the discovery, evaluation, and exploitation of a single founding opportunity (Shane and Venkataraman 2000) treats the identification of opportunities as solely a founding event rather than as a continuous process. This conception not only puts an artificially linear structure on the entrepreneurial process,

but also ignores the ways in which a stream of opportunities post founding affects the evolution of firm strategy. In our study, every firm that pivoted made a strategic addition triggered by an unanticipated opportunity not associated with the founding opportunity. But, in order for these post-founding opportunities to emerge, firms had to be engaged in executing on their original strategy. In other words, only by doing strategy and executing on their beliefs about the founding opportunity, did entrepreneurs discover where new problems and opportunities lay.

Our research shows how firms evolve their strategies through strategic additions and exits prompted by new information that either expanded or conflicted decision makers' beliefs. This suggests that scholars need to extend their research designs to include the non-linear, iterative path of opportunities firms experience post-founding. We cannot establish traction on how strategy evolves without tracing the on-going stream of opportunities that shape strategy evolution. For example, are founding opportunities and on-going opportunities evaluated differently by entrepreneurs? Entrepreneurial action on a founding opportunity is initiated when knowledge about a specific opportunity and belief in one's ability to capture it grow in relationship to some amount of willingness to bear uncertainty (McMullen and Shepherd 2006). On-going opportunities occur in a context where the entrepreneur already has a team and an infrastructure in place to take advantage of them. The existence of the firm is no longer in question when evaluating an unanticipated, post-founding opportunity. In this context, the entrepreneur already has confidence in the firm's viability, as he or she has already decided to start the firm, and will only evaluate the emerging opportunities against the current strategy and the beliefs held. Further research would do well to explore how the on-going stream of opportunities entrepreneurial firms encounter after founding affects firm strategy and ultimately firm success.

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Table 1: Case descriptives at entry to research study

Firm	Founded	Team	Cleantech area	Innovation in	Founder experience
Coulomb	2009	4+	Power Generation	Manufacturing process	2 engineering consultants & 1 engineering professor
Ergon	2010	8	Pollution	Chemical process	2 serial entrepreneur engineers
Farad	2013	4	Power Storage	New application of known science	2 former CTOs from related industry startups
Gauss	2011	4+	Power Generation	New application of known science	2 engineering students
Hartree	2007	15	Pollution	Chemical process	1 experienced engineer entrepreneur
Joule	2011	7	Energy Efficiency	Product design	2 engineering graduates
Ohm	2010	10+	Energy Efficiency	Application of new science	3 engineering graduates & 1 MBA

Table 2: Decision making triggers by firm

<i>Type of trigger</i>	Coulomb	Ergon	Farad	Gauss	Hartree	Joule	Ohm	<i>Total</i>
<i>Content</i>								
Technology		1		3		11	8	23
Market		2		5	1	6	3	17
Financing	4	3	3	5	4	5	6	30
Supply chain	1	4		2				7
Organizational activities	1	2		3	2	3	5	16
<i>Timing</i>								
Impending deadline	1	4	2	4	2	9	10	32
Phase transition	3	5	1	3	3	5	6	26
Following a prior decision	1			4		5	3	13
Other	1	3		7	2	6	3	22
<i>Favorability</i>								
Problem	1	3	2	8	1	10	17	42
Opportunity	5	9	1	10	6	15	5	51
<i>Total</i>	6	12	3	18	7	25	22	93

Table 3: Problem and Opportunity Triggers Prompt Strategy Questions

<i>Firms</i>	Problem	Strategy Question	Opportunity	Strategy Question
<i>Coulomb</i>	“I got to detailed diligence with a group of investors that all looked very good. Then finally the final work came down from everyone and they said, ‘We love what you’re doing, but you’re too far from revenue.’”	<i>If equity investors won’t invest in us until the product is fully developed, how are we going to pay for product development?</i>	“There are a number of scale-up financing opportunities in the EU. Also, Germany and Sweden have specific opportunities. Germany is chasing us right now. They’re very eager to help us open up an office over there.”	<i>Do we open an office in Germany?</i>
<i>Ergon</i>	“All the [US] angels that had interest in cleantech were ganged up already... They said, ‘We don’t want to invest in two companies in the [same industry].’”	<i>Where should we look for our initial funding if angel funding is not available?</i>	“We just had a big decision today whether we want to open an office in Houston. We’re being sort of courted by the State of New York, who really wants us to open with New York as our headquarters.”	<i>Do we stay with our original strategy to open an office in Houston or do we open an office in New York?</i>
<i>Farad</i>	“There’s plenty of money available from commercial [firms] for demo projects. There is a lot of money – but not in cleantech.”	<i>How do we fund the construction of our pilot demonstration machine in cleantech?</i>	“We ended up in the middle of the buffalos with the buffalo stampeding right around the car... The person standing next to me was the President of the [university]... and the next thing you know I’ve got a meeting with his staff about one of the industrial applications.”	<i>Do we open an office in a new state to get access to this particular regional and university funding?</i>
<i>Gauss</i>	“We were on the verge of going out to [customers] to look at some sites that we could deploy at. The [machine] isn’t even running yet... I believe him when he says, ‘I think it should run.’ It doesn’t run.”	<i>Do we continue to use our novel technology or should we use a similar off-the-shelf product?</i>	“We discovered up there that there’s a surprising market... The challenge is that the Board of Directors does not want us to go on a tangent. That would be a distraction.”	<i>How can we tap into this market without spending a lot of resources on market development?</i>

<i>Firms</i>	Problem	Strategy Question	Opportunity	Strategy Question
<i>Hartree</i>	“We’re ultimately going to need a lot of money to do this...The commercialization process will take X number of months once we get private funding”	<i>After funding our technology R&D through grants, where can we get private funds to develop a commercial product?</i>	“I got a call from some guy out of the blue. He said, “Hey, we’d like to get to know you.” I immediately started Googling who the heck they were, because I didn’t know them, and realized that they were a really big company.”	<i>How can we get value from a relationship with this mature firm when their interests are not fully aligned with what we are actually working on?</i>
<i>Joule</i>	“The day before it was time to go [to the industry tradeshow], I tried to pack [the prototype] into its suitcase and I could not get it in the suitcase.”	<i>Do we redesign the product so that it fits the desired size requirements or should we scrap it and start over?</i>	“[A demo for the founder of our target customer] ended with him saying, ‘Here’s my card. Seriously email me. I believe that it may be in the best interest of [us], and of course you guys, if we put [your product] in [ours].”	<i>How do we turn this enthusiasm for our new technology into a contract for products that fit their timeline and requirements?</i>
<i>Ohm</i>	“A number of folks [in the industry] were like: ‘Yeah, this a problem, but it is going to be a really hard market for you guys to break into, and there is a lot of well-funded companies that are quite a bit ahead of you.”	<i>If the market is crowded, do we keep targeting this product for our first market or pick another product?</i>	“Now that people are seeing the news and reading the articles and stuff, we’re getting a lot of inbound requests [for other applications of the technology]... ‘Can you guys do that?’ We’re getting a lot of inbounds in other areas.”	<i>What should our next market be and when should we begin product and market development for it?</i>

Table 4: Strategic Decisions at Risk for Change

		No change <u>Farad Strategy Question:</u> Should we build a prototype for marketing to investors? <u>No Change Decision:</u> “We did think about building what I would call a ‘toy’. I could be wrong about a ton of things. I just think that [building a prototype] would have been a waste of money.” – <i>John Asb, Farad Co-founder</i>	Strategic change <u>Ohm Strategy Question:</u> Should we add a new product to enter a new market? <u>Change Decision:</u> “We sit down probably the same day with everyone and say ‘We could probably do this [new market] thing... We could build a [technologically better] version’...So, we went after it” – <i>Al Marcone, Ohm CTO</i>	Total
	Firms			
No pivot	<i>Coulomb</i>	5	1	6
	<i>Ergon</i>	12		12
	<i>Farad</i>	2	1	3
	<i>Hartree</i>	5	2	7
Pivoted	<i>Gauss</i>	11	7	18
	<i>Joule</i>	19	6	25
	<i>Ohm</i>	18	4	22
	Total	72	21	93

Table 5: Types of Strategic Change Decisions

		Strategic Exit <u>Joule Strategy Question:</u> Do we redesign the product so that it fits the desired size requirements or should we scrap it and start over? <u>Strategic Exit Decision:</u> “This thing is dead. Let’s re-strategize when you get back. We’re going to need to do something completely different.” – <i>Vincent Ward, Joule CTO</i>	Strategic Addition <u>Hartree Strategy Question:</u> Should we acquire one of the four firms that have asked us to acquire them? <u>Strategic Add Decision:</u> “The integration of the technology of both companies will take place over the next 12 months and result in a [product] with outstanding performance to meet exacting standards.” – <i>Hartree Press Release</i>	Total
	Firms			
No pivot	<i>Coulomb</i>		1	1
	<i>Ergon</i>			0
	<i>Farad</i>		1	1
	<i>Hartree</i>		2	2
Pivoted	<i>Gauss</i>	1	6	7
	<i>Joule</i>	2	4	6
	<i>Ohm</i>	2	2	4
	Total	5	16	21

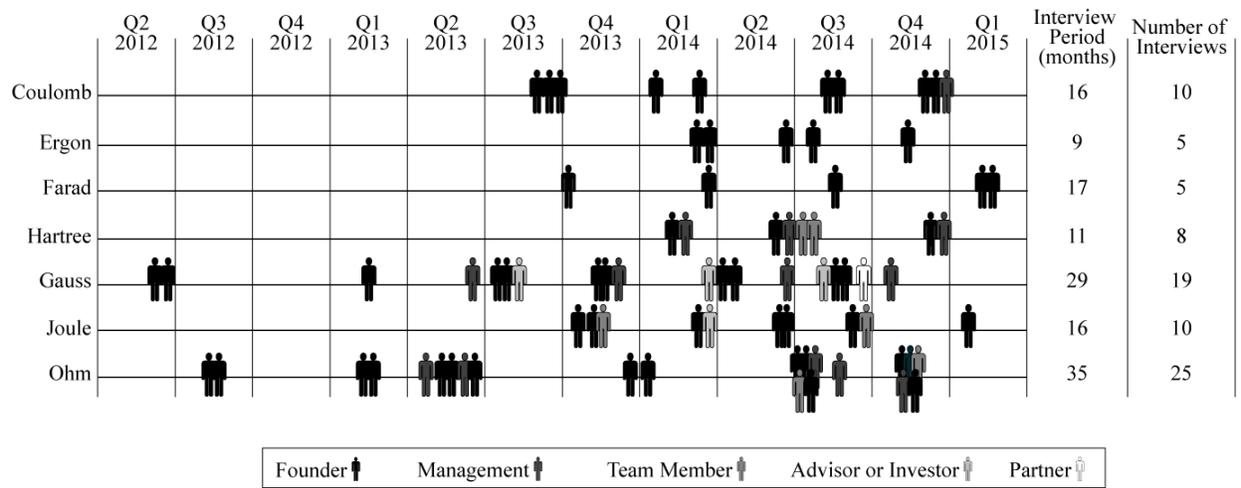


Figure 1: Distribution of Field Interviews

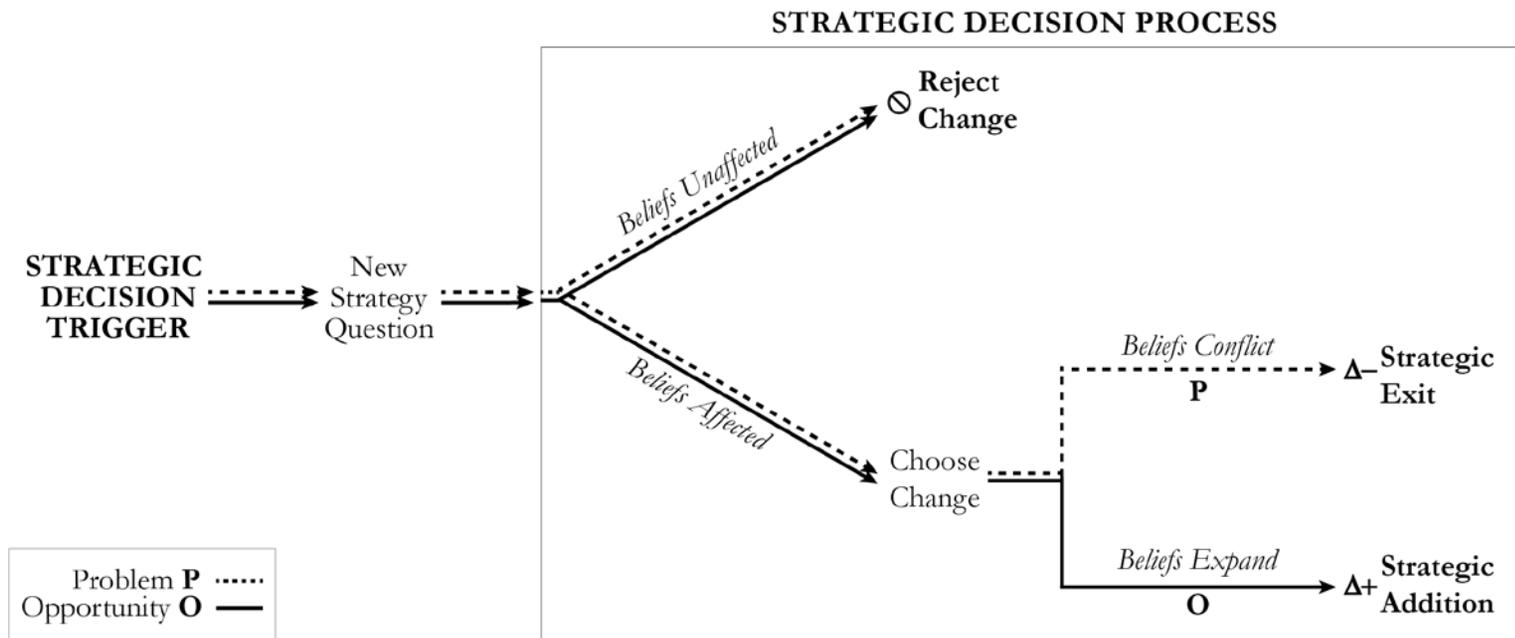


Figure 2: Explaining when firms choose strategic change

