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Causation and effectuation processes: A validation study

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ABSTRACT

We develop and validate measures of causation and effectuation approaches to new venture creation and test our measures with two samples of entrepreneurs in young firms. Our measure of causation is a well-defined and coherent uni-dimensional construct. We propose that effectuation is a formative, multidimensional construct with three associated sub-dimensions (experimentation, affordable loss, and flexibility) and one dimension shared with the causation construct (pre-commitments). As specified by Sarasvathy (2001), we also show that causation is negatively associated with uncertainty, while experimentation, a sub-dimension of effectuation, is positively correlated with uncertainty. The major contribution is the resulting validated scales that measure causation and effectuation.

1. Executive summary

An awareness of the actions and behaviors of entrepreneurs is critical to understanding an entrepreneurial economy. In her groundbreaking research, Sarasvathy (2001, 2008) advanced our understanding of the entrepreneurial process by describing two distinct approaches to new venture creation: causation and effectuation. While causation is consistent with planned strategy approaches, including such activities as opportunity recognition and business plan development, effectuation processes are consistent with emergent strategy and include a selection of alternatives based on loss affordability, flexibility, and experimentation. Sarasvathy (2008) uses the contrasting metaphors of a jigsaw puzzle and a patchwork quilt to capture the differences between the two approaches. In the jigsaw puzzle approach (causation) the entrepreneur's task is to take an existing market opportunity and, through the use of resources, create a sustainable competitive advantage. The assembler of jigsaw puzzles sees the world as one in which all of the pieces are there, but must be assembled. In the patchwork quilt approach (effectuation) the task of the entrepreneur is to develop the opportunity by experimenting and changing direction as new information becomes available. The patchwork quilter sees the world as still in-the-making with a significant role for human action (Sarasvathy, 2008).

While Sarasvathy has done a masterful job of articulating the constructs, our research addresses the next critical step in advancing this research — the development of validated measures of both causation and effectuation processes. Thus, we contribute by developing measures and analyzing the empirical distinctions between causation and effectuation. Specifically, we make several key contributions. First, using data from two field samples, we develop and refine measures of causation and effectuation. Next, we use these measures to test the dimensionality of the constructs and the associated distinctiveness of each as suggested by Sarasvathy (2001). In addition, we show that causation measures are negatively related to measures of uncertainty and the experimentation sub-dimension of effectuation is positively related to measures of uncertainty, providing support for the theoretical

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conceptualization of causation and effectuation. Finally, we position our findings in the entrepreneurship literature and propose that scholars undertake a research stream to examine entrepreneurial processes utilizing the measures developed and tested in this study.

Beyond the implications for scholars, this research also has implications for practitioners. The path to new venture creation may follow a well-defined causation approach in which those who identify opportunities, bring together resources efficiently, and work according to a plan may achieve competitive advantage; however, the path to new venture creation may also be a process of experimentation, affordable loss, and flexibility that results in entrepreneurial success. While it will be up to future research to determine the circumstances under which each approach is more appropriate for a particular individual or an opportunity, our findings should be validating for the legions of would-be entrepreneurs who wage a dichotomous war between the need to "develop a full-blown business and marketing plan" and the need to "just get started."

2. Introduction

Causation and effectuation are two alternative approaches that entrepreneurs use in the new venture development process (Sarasvathy, 2001). Causation is consistent with planned strategy approaches (Ansoff, 1988; Brews and Hunt, 1999; Mintzberg, 1978). The planning and analysis required by such models assume conditions in which the distribution of outcomes in a group is predictable through calculation or statistical inference (Sarasvathy, 2001).

In contrast, effectuation processes (Sarasvathy, 2001) are consistent with emergent (Mintzberg, 1978) or non-predictive strategies (Wiltbank et al., 2006). Under conditions of uncertainty, unique circumstances make it impossible to draw statistical inferences. In addition, there is no feasible way to calculate an expected return for a given course of action. Thus, instead of analyzing alternatives and selecting the one with the highest expected return, the entrepreneur selects alternatives based on loss affordability. The entrepreneur maintains flexibility, utilizes experimentation, and seeks to exert control over the future by making alliances with, and getting pre-commitments from, potential suppliers, competitors, and customers.

To date, most of the empirical research on causation and effectuation has been either experimental studies that analyze the think aloud verbal protocols of entrepreneurs as they make decisions (e.g. Dew et al., 2009; Sarasvathy et al., 1998; Sarasvathy et al., 1998) or field studies that have gathered and analyzed qualitative data (Sarasvathy and Kotha, 2001; Sarasvathy and Dew, 2005; Harting, 2004; Harmeling, 2005). To move the research stream from a nascent to an intermediate phase it is necessary to develop and validate quantitative measures (Edmondson and McManus, 2007). Wiltbank et al. (2009) took a step in that direction when they measured the prediction and control aspects of effectuation. Our research contributes to this stream of inquiry by constructing measures of additional dimensions of effectuation that are theoretically significant, but have not yet been developed. This is important because it will provide empirical measures to allow future researchers to study the antecedents and outcomes of causation and effectuation with larger sample sizes that will allow statistical analysis and verification.

It is our objective to promote empirical research that focuses on causation and effectuation by developing sound measures of each and by providing evidence supporting the reliability and validity (construct, content, face, and predictive) of these measures. Construct validity is defined as the extent to which an operationalization reflects the concept it is supposed to measure (Cook and Campbell, 1979; Nunnally and Bernstein, 1994) and has been highlighted as a central issue in organizational research (e.g. Mitchell, 1985; Schwab, 1980; Webb and Weick, 1979). Content and face validity relate to the adequacy with which the construct domain was sampled and the intuitiveness of the connection between the items and the construct (Nunnally and Bernstein, 1994). Finally, the predictive validity provides empirical evidence of the relationship between the construct and other theoretically relevant constructs (Nunnally and Bernstein, 1994). We address each of these validity perspectives in developing and validating these measures of causation and effectuation. We use a multi-stage process consisting of semi-structured interviews with entrepreneurs, item generation from theory and interviews, instrument pre-testing with MBA students, initial testing with 111 firm founders, re-conceptualization, re-testing with an additional 196 firm founders, item refinement, and expert review using a modified q-sort. In the initial test we examine the constructs and utilize exploratory factor analysis to examine inter-relationships among variables and the common underlying dimensions. In the second study we build upon the findings in the first study and utilize confirmatory factor analysis to determine if the factors conform to what is expected on the basis of Sarasvathy's (2001) theoretical perspective. We then discuss our findings within the existing entrepreneurial literature and propose a research stream to examine the generalizability of our findings as well as the relevance of causation and effectuation approaches to entrepreneurship.

3. Theoretical considerations

3.1. Causation and effectuation processes

According to Sarasvathy (2001: 245), "Causation processes take a particular effect as given and focus on selecting between means to create that effect." In new venture creation, entrepreneurs following a causation process clearly define the objectives they want to accomplish up front and systematically search (Fiet, 2002; Herron and Sapienza, 1992) for entrepreneurial opportunities within developed industries that meet those objectives. They evaluate and select opportunities that maximize expected returns (Drucker, 1998). They engage in analysis and planning activities as they seek to exploit their pre-existing knowledge and resources. Thus, the venture is envisioned from the beginning and all efforts are directed at achieving the pre-

envisioned state. According to Sarasvathy (2001: 251), the underlying logic is, "To the extent we can predict the future, we can control it."

The theoretical foundations for the causation process derive from the rational decision making perspectives of neo-classical micro-economics (Stigler, 1952). In a causation process an individual makes rational choices based on all possible information relevant to his decision and an estimated expected utility for each option (Viale, 1992). Much of the existing entrepreneurship literature has theoretical foundations in the causation approach. For example, in the research on opportunity discovery, Fiet (2002) suggests that opportunity detection results from a rational search process in which alternatives are identified and analyzed. The alternative with the highest expected return is selected and implemented. Entrepreneurial opportunities are driven by exogenous forces, and the role of the entrepreneur is to examine the environment and existing projects in the marketplace, utilize a sequential screening process, and choose the project with the highest expected return (Casson and Wadeson, 2007). Thus, entrepreneurial rents accrue to individuals with superior search and implementation skills (Caplan, 1999).

The business plan and its popularity in both entrepreneurship practice and pedagogy is another example of institutional conformity to the causation approach. Many textbooks on entrepreneurship are built around business planning models (e.g. Allen, 2003; Kuratko and Hodgetts, 2004; Scarborough and Zimmerer, 2003; Timmons and Spinelli, 2004). The development of a business plan "…is a rational activity that assists the owners of new firms (entrepreneurs) to earn larger profits through efficiency gains and/or increased sales" (Honig and Karlsson, 2004: 35). Although the empirical research regarding the effectiveness of business plans has been mixed (Honig and Karlsson, 2004; Liao and Gartner, 2006), the business plan with its step-by-step rational process is a primary deliverable in many university entrepreneurship programs.

In contrast, Sarasvathy (2001: 245) states that effectuation approaches "…take a set of means as given and focus on selecting between possible effects that can be created with that set of means." In new venture creation, entrepreneurs following an effectuation approach might begin the new venture process with general aspirations to create a new venture, but as they make decisions and observe the results of those decisions, they utilize this new information to change course. Because the future is unpredictable, entrepreneurs using an effectuation approach may try different approaches in the marketplace before settling on a business model. In addition, they are likely to put mechanisms into place that allow them to have some control over the outcome. According to Sarasvathy (2001: 251), the underlying logic is, "To the extent we can control the future, we do not need to predict it." The theoretical foundations of an effectuation approach lie in cognitive science, particularly the work which emphasizes entrepreneurial framing — how entrepreneurs view inputs (relevant or not), make inferences, perceive alternatives, and attend to constraints (Dew et al., 2009; Johnson and Lakoff, 2002). Sarasvathy's (2001) theoretical conceptualization and the ensuing empirical work (Dew et al., 2009; Sarasvathy and Kotha, 2001; Sarasvathy et al., 1998) have demonstrated that entrepreneurs following an effectual logic are less likely to try to predict the future and are more likely to change their initial goals and visions for the new venture. Rather than predicting the future, they are more likely to work with means within their control and make adjustments as necessary (Dew et al., 2009). Using effectual logic they frame the future as resulting from co-creation by intentional agents (networks of partnerships consisting of investors, partners, and customers) who are "stitched together" (Dew et al., 2009). Goals emerge by developing potential courses of action that are based on the available means of who a person is, what they know, and whom they know.

3.2. Differences between causation and effectuation

The key differences between causation and effectuation are outlined in this section of the paper and form the basis of the measures that we subsequently develop. Based on our careful reading of Sarasvathy (2001), we have outlined four principles that differentiate causation and effectuation approaches: (1) a focus on short-term experiments to identify business opportunities in an unpredictable future (effectuation) versus prediction of an uncertain future by defining the final objective up front (causation), (2) a focus on projects where the loss in a worst-case scenario is affordable (effectuation) versus maximization of expected returns (causation), (3) an emphasis on pre-commitments and strategic alliances to control an unpredictable future (effectuation) versus business planning and competitive analyses to predict an uncertain future (causation), and (4) exploitation of environmental contingencies by remaining flexible (effectuation) versus exploitation of pre-existing capabilities and resources (causation).

Although Sarasvathy defined key differences between causation and effectuation, few researchers have attempted to empirically test effectuation and causation. Therefore, armed with a theoretical description of these processes, we sought to create measures that would allow us to differentiate between start-up processes following a predominant logic of causation vs. those following a predominant logic of effectuation.

Our work contributes to the developing stream of empirical research that investigates entrepreneurial decision making under conditions of uncertainty (Wiltbank et al., 2009; Dew et al., 2009). This stream of literature is in the early stages of construct development and has most often used qualitative methods to gather information. For instance, Dew et al. (2009) use think aloud protocols to capture decision making while Wiltbank et al. (2009) develop a scenario-type instrument to capture hypothetical angel investment decisions in an innovative computer company. Further, in this latter study, the focus is on only the prediction and control dimensions, and does not include experimentation, affordable loss, flexibility, and pre-commitments. Thus, our study is the first that has developed Likert-type measures that capture the more broadly defined effectuation construct. Our study thus helps move our understanding of effectuation forward by providing reliable and valid operationalizations that can be employed in a survey format and in a variety of contexts. We add to the literature by building upon the insights of Sarasvathy (2001) and Dew et al. (2009) to explicitly capture the multidimensional nature of effectuation. Furthermore, we focus our attention on the application of causation and effectuation to new venture creation. This is the original focus of Sarasvathy's (2001) work, although

the empirical work since (e.g. Dew et al., 2009; Wiltbank et al., 2009) has focused on different aspects of the entrepreneurial process (e.g. investing, market development, etc.).

4. Methods

4.1. Overview

We next set out to link the theoretical concepts described above to empirical measures. After carefully defining the differences between causation and effectuation we used a four stage process to develop the scale items. First, we conducted 35 semi-structured interviews with entrepreneurs in the sampling frame and paid close attention to the language they used to describe their start-up processes. The interviews were conducted over the telephone by one trained interviewer and lasted an average of about 20 min. We asked semi-structured questions about how the opportunity was identified, the sequence of venture development events and the involvement of other people or organizations. When the interviewer considered it necessary respondents were prompted to explain how and why they made the decisions they did. Our objective with regards to causation and effectuation was to capture descriptions of the constructs described by Sarasvathy (2001) in the vernacular used by a group of entrepreneurs in our sampling frame. Terminology for questionnaire items was adopted when the two researchers who developed the survey agreed that certain words or phrases were consistent with either the causation or effectuation construct. Then, we designed a survey that sought to capture the causation and effectuation constructs defined by Sarasvathy (2001) in the terms used by entrepreneurs in interview responses. Thus, the conceptual framework came from Sarasvathy (2001), but we attempted to employ language consistent with that used by entrepreneurs in the interviews. Specific questionnaire items are subsequently presented in the measurement sections of the paper. Data were collected and analyzed. This analysis led to a re-conceptualization of the effectuation construct in which we wrote and included items to measure each sub-dimension adequately. Next, using the revised measures, we collected new data and re-analyzed the items and scales. Finally, to address the face and content validity of the scale items we engaged five active, Ph.D. holding, researchers from the fields of strategy and entrepreneurship to examine the scale items using a modified q-sort approach (Nag et al. 2007; Stephenson, 1953).

The statistical analyses were conducted on data from the two studies of entrepreneurs in early-stage ventures. In both studies we followed the Total Design Method (TDM) described by Dillman (2000). This included mailing questionnaires, accompanied by prepaid return envelopes and cover letters, to the lead entrepreneurs of the firms in the sample frame. The cover letters identified the sponsor of the study and explained its purpose and importance. We assured entrepreneurs of confidentiality and promised them a report of the aggregated findings once the study was completed. A follow-up postcard and reminder letter with a replacement survey questionnaire followed the initial mailing.

In both studies we pre-tested the research instrument. In the first study we pre-tested the instrument with 18 members of an on-campus MBA class and with ten entrepreneurs in the utilized sampling frame. In the second study we pre-tested the instrument with 12 members of an on-campus MS program. Pre-tests were utilized to provide insight into difficult questions, survey design, etc., and led to several minor changes in the first instrument. Few changes resulted from the second pre-test indicating respondents were able to understand and complete the revised survey.

Our research uses responses from a single respondent in each company along with secondary data from Dun & Bradstreet. Using one informant per organization has been supported when survey instruments are well designed (Starbuck and Mezias, 1996), and the key respondent is the owner/manager of the business (Chandler and Lyon, 2001). Frequently in new firms the lead entrepreneur is the only person with the requisite knowledge of new venture activities. Non-response bias is also a concern when response is voluntary; non-responding firms (in either study), however, did not differ significantly from responding firms on measures included in the Dun & Bradstreet data (annual sales, geographic area, or SIC code).

A variety of recommendations have been made regarding the minimum sample size needed for stable factors. Although Hair et al. (2006) recommend a sample-to-variable ratio of 20:1, several researchers have suggested that 5:1 is adequate (Bryant and Yarnold, 1995; Everitt, 1975; Gorsuch, 1974; Gorsuch, 1983). Arrindell and van der Ende (1985) used two large data sets to examine the minimum sample sizes and ratios and found stable factor structures with ratios as low as 1.3:1 and sample sizes less than 100. Guadagnoli and Velicer (1988) found that absolute sample size was more important than ratios of items to sample size in determining stable solutions and state that sample size of 100 to 200 are adequate for most factor solutions. In our first study, the ratio is approximately 7:1 and the sample size exceeds the minimum of 100 recommended by Guadagnoli and Velicer (1988). For the second study, the ratio is 9:1 and the sample size is almost 200. Thus, both samples exceed minimum recommendations.

4.2. Study One

4.2.1. Data

The sampling frame for the first study came from the 2002 Dun & Bradstreet directory, which contains information on over 132,500 companies (90% of which are private). The database contained contact information and secondary data such as start-up date, employment figures, and SIC Codes. We selected two four-digit codes — electrical measurement instruments (SIC 3825) and surgical and medical instruments (SIC 3841) — which included 1334 two to five-year old firms. These industries were selected for three reasons. First, we had some familiarity with the industries. Second, our initial interviews revealed that both causation and effectuation processes were being used in these industries, and third, there are a relatively large number of recent start-ups in both industries. We eliminated 272 firms from the sample due to duplications, incorrect addresses, and disconnected phone numbers,

leaving a sampling frame of 1062 firms. One hundred and eighty-nine entrepreneurs responded with usable surveys for a response rate of 17.8%. Of the entrepreneurs who responded, 91% were firm founders. For the analysis, we retained only those respondents who were firm founders. We limited the age of the firm to 5 years or less to reduce the instability of recall data. Responding firms averaged 3.2 years of age and had 6.73 employees; one firm was eliminated from the analysis because the firm size was a significant outlier (the firm that was eliminated from analysis had 1300 employees). After eliminating the inappropriate respondents, 111 respondents remained for the analysis. Forty-two percent of the responding firms were in the electrical measurements industry; 58% were in the surgical and medical devices industry.

4.2.2. Measures

4.2.2.1. Causation processes. Components of the causation process as described by Sarasvathy (2001) include envisioning the end from the beginning, maximizing expected returns, business planning and competitive analyses to predict an uncertain future, and exploiting pre-existing knowledge. Initially, we developed nine items to capture the causation construct. See Column 1 of Table 1 below for specific items.

4.2.2.2. Effectuation processes. When entrepreneurs use effectuation processes they experiment with alternatives in which potential losses in the worst-case scenario are affordable, they use pre-commitments and strategic alliances in an attempt to control an unpredictable future, and they remain flexible so they can take advantage of changing environmental contingencies. We developed eight items to capture the key dimensions of effectuation. See Column 1 of Table 1 for specific items. Both scales were measured using five point Likert-type items, anchored by "strongly disagree" and "strongly agree."

4.2.3. Data analysis

We used exploratory factor analysis to explore the underlying dimensionality of the 17 items. In addition we used parallel analysis (Horn, 1965) and scree analysis (Cattell, 1966) of the eigenvalues to determine the number of factors to extract from the data. Parallel analysis is a more conservative and accurate approach to factor extraction that takes into account the biasing influence of sampling error (Zwick and Velicer, 1986). The method of parallel analysis described in Hayton et al. (2004) was employed to generate the factor retention criteria.

Prior to factor analysis, the factorability of the data was assessed. Each of the individual variables exceeded the cut-off value of .50 suggested by Hair et al. (2006). We also applied Bartlett's test of sphericity (1950) and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy (Kaiser, 1970). The KMO should be greater than 0.5 and the Bartlett test significant ($p<.05$) before proceeding with factor analysis (Arnold et al., 2007; Bartlett, 1950; Kaiser, 1970). We found a KMO value of .669 and a significant Bartlett's test (chi-square 397.3, $p<.000$), indicating that factor analysis is appropriate. To assist in the interpretation of the resulting factor solution, we used both orthogonal and oblique rotations. The items loading on each factor were identical using both methods.

Table 1
Results from Study One — causation and effectuation items and loadings.

Items	Causation (C) Effectuation (E)	Items retained after parallel factor analysis	Factor 1	Factor 2	Factor 3
We analyzed long run opportunities and selected what we thought would provide the best returns	C	X	.70		
We developed a strategy to best take advantage of resources and capabilities	C	X	.69		
We researched and selected target markets and did meaningful competitive analysis	C	X	.67		
We designed and planned business strategies	C	X	.68		
We organized and implemented control processes to make sure we met objectives	C	X	.57		
We had a clear and consistent vision for what we wanted to do	C	X	.59		
We designed and planned production and marketing efforts	C	X	.56		
The ultimate product/service that I used to launch this business was quite similar to my original conception	C	X			.82 [a]
Our decision making has been largely driven by expected returns	C				
The ultimate product/service that I used to launch this business was quite different from my original conception	E	X			.82
It was impossible to see from the beginning where we wanted to end	E	X		.64	
We have allowed the business to evolve as opportunities have emerged	E	X		.58	
We evaluated the set of resources and means we had at our disposal and thought about different options	E				
We experimented with different products and/or business models	E				
We started out very flexibly and tried to take advantage of unexpected opportunities as they arose	E	X		.36	
We used a substantial number of agreements with customers, suppliers and other organizations and people to reduce the amount of uncertainty	E	X	.46		
Our decision making has been largely driven by how much we could afford to lose	E	X		.47	

[a] Reverse coded.

Sarasvathy's (2001) proposal that causation and effectuation are two different approaches to new venture creation suggests a two-factor solution in which causation items should load on one-factor and effectuation items should load on another. What was immediately apparent is that causation items tended to load together, but effectuation items did not. See Table 1 for these results. The results of the parallel analysis and scree analysis suggested that at least three factors should be retained (see also Hayton et al., 2009). Cronbach's alpha for the causation items was .73 suggesting that the scale is internally consistent. However, following recommendations by Thompson and Daniel (1996) and others (Fabrigar et al., 1999; Zwick and Velicer, 1986) we concluded that the preponderance of the evidence suggested that effectuation is a multidimensional construct.

In fact, based on the empirical results that we obtained in these analyses and the conceptual differences among the sub-components of effectuation, we believe that effectuation may in fact be a formative construct, as opposed to a reflective construct. A formative construct implies that causality flows from lower-order indicators (items, sub-constructs) to the latent, higher-order constructs (Coltman et al., 2008; Jarvis et al., 2003) whereas a reflective construct implies the opposite. In other words, for formative constructs the higher-order constructs are "formed" by the lower-order ones and for reflective constructs, the lower-order ones are designed to "reflect" the upper-order ones. Furthermore, for formative constructs, the causal nature of the relationship, where the lower-order measures shape the upper-order construct, also suggests that the lower-level indicators are defining characteristics of the construct and may therefore be independent of each other (MacKenzie et al., 2005). This implies that the sub-components should not be changed or deleted; doing so might substantially alter the upper-level construct (Diamantopoulos and Winklhofer, 2001; MacKenzie et al., 2005). For the construct of effectuation, we note that the multiple sub-dimensions are vital components of effectuation and, together, help define effectuation. The individual conceptual differences help form effectuation and their removal would imply that effectuation has a different meaning. We return to this discussion of effectuation as a formative construct in Study Two and examine the sub-components in more depth in the following section.

4.2.4. Discussion and re-conceptualization

A subjective analysis of the causation items above provides evidence supporting the face validity and content validity of their use in measuring causation. This evidence is provided in two ways. First, when considered holistically, the items are consistent with the causation construct as described by Sarasvathy (2001), thus providing face validity. Second, the range of items included in the measure sample from the entire domain of the construct, providing additional evidence for the scale's content validity.

However, the results were not as clear for effectuation. Items intended to measure effectuation did not load cleanly on a single factor. Instead we identified at least three factors, as we describe above. Unfortunately, the items we had constructed were not adequate to capture all of the relevant sub-dimensions that help form the construct of effectuation. As a result, we returned to the original theoretical conceptualization and the "principles that form the core of a rudimentary theory of effectuation" (Sarasvathy 2001: 252). She identifies four principles: 1) focusing on short-term experiments, 2) focusing on projects where the loss in a worst-case scenario is affordable, 3) emphasizing pre-commitments and strategic alliances to control an unpredictable future, and 4) exploiting environmental contingencies by remaining flexible. Each of these dimensions of effectuation has had some, albeit limited, discussion in other contexts in the management and entrepreneurship literature. We explore these dimensions here and briefly examine the previous literature.

Effectuators are likely to try different approaches in the marketplace before settling on a business concept (Sarasvathy, 2001). The literature indicates that one way to test different approaches in the marketplace is through *experimentation*. Although the existing literature has not associated experimentation with new venture creation, several studies (e.g. Brown and Eisenhardt, 1997; Koberg et al., 2003) exploring innovation in the established firm have found experimentation to be a relatively low cost method of probing into the future (Brown and Eisenhardt, 1997). Experimentation has been described as "a series of trial and error changes pursued along various dimensions of strategy, over a relatively short period of time, in an effort to identify and establish a viable basis for competing" (Nicholls-Nixon et al., 2000: 496). As part of the process of defining an appropriate business model, experiments that turn out poorly are truncated early and the entrepreneur can explore other avenues. McGrath (1999) points out that in real options reasoning, investment can be shifted away from experiments that are not turning out well. Thus, consistent with real options reasoning (McGrath, 1999), the effectuation process may be viewed as a series of experiments to identify a business model that works.

A second dimension identified by Sarasvathy (2001) is that of *affordable loss* rather than expected returns. "Effectuation predetermines how much loss is affordable and focuses on experimenting with as many strategies as possible" (Sarasvathy, 2001: 252). Affordable loss becomes an important criterion on which to base start-up decisions. Experiments that would cost more than the entrepreneur can afford to lose are rejected in favor of affordable experiments. Thus, following an effectuation approach each "new venture" would be viewed as an experiment in which losses are contained. Additional resources would be added only as justified by results.

The third dimension identified by Sarasvathy is that effectuators tend to remain *flexible* since the structure of the emerging organization is dependent on contingent opportunities and the particular investments made by the stakeholders. Thus, "the need for prediction is greatly reduced" (Sarasvathy, 2001: 252). The literature has viewed flexibility as one of the advantages that start-up firms have over the established firm. As firms become established and grow they must implement policies, procedures, and routines (March and Simon, 1958) whereas entrepreneurs (and especially effectuators) maintain the flexibility necessary to abandon unfruitful experiments, and move to other possibilities.

Fourth, effectuators rely on *pre-commitments* and strategic alliances rather than competitive analysis. The logic behind developing alliances and getting pre-commitments is that if entrepreneurs can control the future by establishing these relationships and commitments, they do not need to predict it (Sarasvathy, 2001). The importance of strategic alliances and partnerships for emerging business has been discussed by multiple researchers (e.g. Eisenhardt and Schoonhoven, 1996; Sarkar

et al., 2001). Establishing *pre-commitments* and alliances with customers, suppliers, and other strategic partners helps reduce the uncertainty associated with the venture and spreads responsibility to other stakeholders. This process of diversifying risk among multiple stakeholders also allows the effectuator to constrain the potential loss, thus making it more affordable. The results from Study One and the resulting theoretical development confirm the need to collect additional data to validate the findings regarding causation and to explore the nature of effectuation. In addition, we believe the results of the first study are indicative that effectuation may be a formative construct. The literature on model specification and formative constructs offers a number of conceptual tests that help determine whether a reflective or formative approach to construct development is more appropriate (Coltman et al., 2008; Jarvis et al., 2003; MacKenzie et al., 2005). The first test is to examine the nature of the construct itself and whether the lower-level components are likely to cause changes in the upper-level latent construct or the other way around. While we do acknowledge that effectuation is a way of entrepreneurial thinking that may have the ability to direct behavior, we argue that the specific actions and manifestations of the sub-components (experimentation, affordable loss, flexibility, and pre-commitments) are aggregated to form the effectuation construct. Therefore, the degree to which one effectuates is an amalgamation of involvement in each of the sub-dimensions of effectuation.

The second test is to examine whether the component parts are interchangeable. For reflective constructs, there should be a common theme or potential to inter-change the component parts. However, based on our discussion of the different factors above, we note that they are each conceptually distinct from each other and tap into varying dimensions of effectuation. Two further tests consider the potential co-variance among the sub-components such that changes in one component would necessarily be associated with changes in the other, and whether the antecedents/consequences of each component may differ. For effectuation and its component factors, the conceptual differences among the factors suggest that not all of the factors need to vary with each other. For formative measures, because each sub-construct helps contribute a novel area of importance to the overall latent concept, the components do not need to be correlated (MacKenzie et al., 2005). In our view, this is the case of the sub-components for effectuation. Moreover, although we argue that one of the most important potential antecedents might be the factor of uncertainty (based on Sarasvathy's arguments), we do feel that other antecedents and consequences differ among sub-components.

4.3. Study Two

4.3.1. Data

The sampling frame for the second study came from the 2005 Dun & Bradstreet directory. The database contained contact information and secondary data such as start-up date, employment figures, and SIC Codes. We selected two four-digit codes — plastic products (SIC 3089) and prepackaged software (SIC 7372). This resulted in a nation-wide sample frame of 1500 two to five-year old firms. These industries were selected because we had some familiarity with the industries and because there are a relatively large number of recent start-ups in both industries. This allowed us to have some control over industry influences. In addition, after forming the scales, we checked for significant differences between industries and found none. The first study used a sample from two different SIC codes. Thus, the combined studies included four, four-digit SIC codes in somewhat diverse industries.

We eliminated 354 firms because of bad addresses, resulting in an effective mailing list of 1146 firms. One hundred ninety-six firms responded with usable results for a response rate of 17.1%. The selection of two- to five-year old firms was based on an assumption that start-up processes may take a year or two (or sometimes more). We limited our sample to firms that were 5 years or newer to reduce the instability of recall data.

Responding firms averaged 3.8 years of age and had an average of 14.4 full time employees. Of the CEOs responding 79% were male. Fifty-six percent of the responding companies were in the plastics products industry (SIC 3089) and the remaining 44% were in the packaged software industry (SIC 7372). There were no significant differences between respondents and non-respondents with respect to employment levels and industry representation.

4.3.2. Measures

4.3.2.1. Causation processes. To measure causation processes, we used the seven items validated by the first study (Study One $\alpha = .73$, Study Two $\alpha = .78$). See Table 2 below for a complete list of the items.

4.3.2.2. Effectuation processes. As noted above, we suggest that effectuation is a formative construct consisting of the sub-dimensions of experimentation, affordable loss, flexibility, and pre-commitments. Using five point Likert-type items, anchored by "strongly disagree" and "strongly agree," entrepreneurs were asked to "consider the start-up phase of your venture and indicate the degree to which you agree or disagree with each of the following statements." See Table 2 below for a complete list of the items.

Experimentation is a four item scale ($\alpha = .78$) developed from description of Sarasvathy (2001) and the work of Brown and Eisenhardt (1997) and Koberg et al. (2003). Because the items used by Koberg et al. (2003) were developed to measure innovation in a corporate entrepreneurial context we adjusted the measures to reflect the new venture creation scenario. For example, one item states "We experimented with different products and/or business models."

Table 2
Results from Study Two — causation and effectuation items and loadings.

Items	Construct	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
We analyzed long run opportunities and selected what we thought would provide the best returns	Causation	.62				
We developed a strategy to best take advantage of resources and capabilities		.55				
We designed and planned business strategies		.74				
We organized and implemented control processes to make sure we met objectives		.62				
We researched and selected target markets and did meaningful competitive analysis		.76				
We had a clear and consistent vision for where we wanted to end up		.51				
We designed and planned production and marketing efforts		.74				
We experimented with different products and/or business models.	Experimentation		.63			
The product/service that we now provide is essentially the same as originally conceptualized.			.85 [a]			
The product/service that we now provide is substantially different than we first imagined.			.82			
We tried a number of different approaches until we found a business model that worked.			.75			
We were careful not to commit more resources than we could afford to lose.	Affordable loss			.88		
We were careful not to risk more money than we were willing to lose with our initial idea.				.87		
We were careful not to risk so much money that the company would be in real trouble financially if things didn't work out.				.57		
We allowed the business to evolve as opportunities emerged.	Flexibility				.75	
We adapted what we were doing to the resources we had.					.70	
We were flexible and took advantage of opportunities as they arose.					.71	
We avoided courses of action that restricted our flexibility and adaptability.					.62	
We used a substantial number of agreements with customers, suppliers and other organizations and people to reduce the amount of uncertainty.	Pre-commitments					.69
We used pre-commitments from customers and suppliers as often as possible.						.83

[a] Reverse coded.

To measure *affordable loss*, we developed a three item scale ($\alpha = .85$) focusing on predetermining the amount of affordable loss and choosing strategies within those given means (Sarasvathy, 2001). An example item states "We were careful not to commit more resources than we could afford to lose."

To measure *flexibility*, we developed a four item measure ($\alpha = .70$) which reflects the extent to which entrepreneurs remained flexible. For example, one item states "We allowed the business to evolve as opportunities emerged."

We measured *pre-commitments* with a two-item scale ($\alpha = .62$). An example item states "We used a substantial number of agreements with customers, suppliers and other organizations and people to reduce the amount of uncertainty."

4.3.3. Data analysis

As discussed previously, we suggest effectuation is a formative construct. In particular, following the characterizations of formative constructs explained in Diamantopoulos (2008) and Jarvis et al. (2003), we treat effectuation as a formative second-order construct consisting of reflective first-order sub-components (i.e. Type II in their discussions). From a practical perspective, this implies that we employ the commonly-espoused approaches and statistics to evaluate validity and reliability for the first-order constructs (experimentation, affordable loss, flexibility, and pre-commitments) such as principal components analysis, Cronbach's alpha, etc. Treating the sub-constructs as reflective constructs is appropriate, even though the second-order construct 'effectuation' is a formative construct (see Cadogan et al., 2008).

Prior to factor analysis, the factorability of the data was assessed. Hair et al. (2006) suggest that the cut-off range for sampling adequacy is .50. All of the individual variables included in the analysis exceed the cut-off of .50. We also applied the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy (Kaiser, 1970) and Bartlett's test of sphericity (Bartlett, 1950). The KMO should be greater than 0.5 and the Bartlett test significant ($p < .05$) before proceeding with factor analysis (Arnold et al., 2007; Bartlett, 1950; Kaiser, 1970). We found a KMO value of .766 and a significant Bartlett's test ($\chi^2 = 1308.7$, $df = 190$, $p < .000$) indicating that factor analysis is appropriate. To assist in the interpretation of the resulting factor solution, we used both orthogonal and oblique rotation. The items loading on each factor were identical using both methods.

4.3.3.1. Validity. There is evidence for the content, face, predictive, and construct validity of the measures of causation and the four sub-constructs of effectuation. As specified by Nunnally and Bernstein (1994), content validity was supported by several indicators. First, we conducted a thorough review of the literature and Sarasvathy's (2001) construct articulation to ensure a sound understanding of both constructs. Second, we followed a well-formulated procedure for item construction, sampling from the entire breadth of the construct and sub-component domains. Third, we observed adequate levels of internal consistency among items measuring the construct of causation and the sub-constructs of effectuation. Taken together, these procedures and findings support the content validity of the measures.

To provide further evidence supporting the face validity of the scale items, we used a modified q-sort approach (Stephenson, 1953). We engaged five active, Ph.D. holding, researchers from the fields of strategy and entrepreneurship to examine the scale items. The researchers were from two different universities in the United States and none had any prior connection with the research. Researchers were given the instructions "Based on the descriptions below please indicate whether the items listed in the table best represents the construct of causation or effectuation." With respect to their assignment of the items to the two constructs, we

calculated the inter-rater reliabilities for the seven causation items to be 97.5% and for the 13 effectuation items to be 87.7%. These reliabilities signify a high level of face validity for the first-order constructs. In phase two we asked the researchers to use the items they selected as representative of the effectuation construct and to assign these items into the sub-categories. The inter-rater reliability ranged from 60% for affordable loss to 80% for pre-commitments. While lower than the inter-rater reliabilities found for the first-order constructs, these represent relatively strong inter-rater reliability for second-order constructs.

Construct validity includes both convergent validity and discriminant validity inferences (Campbell and Fiske, 1959; Nunnally and Bernstein, 1994). Convergent and discriminant validity may be assessed empirically using confirmatory factor analysis (CFA) procedures (Bagozzi et al., 1991). When items that are theorized to load together on the same construct actually do so it provides evidence of convergent validity. When items intended to load on different constructs actually do so it provides evidence of discriminant validity.

Predictive validity is assessed by showing that the constructs relate to theoretically appropriate criterion (Nunnally and Bernstein, 1994). In this case, Sarasvathy (2001) states that entrepreneurs are more likely to use effectuation processes under conditions of uncertainty. Therefore, measures of uncertainty should be more strongly correlated with measures of effectuation than they are with measures of causation. It is important to note that each of the different sub-components of effectuation need not have similar correlations with uncertainty as they each provide a different piece of effectuation.

Descriptive statistics and intercorrelations of key variables in the study are displayed in Table 3. As can be seen in the correlation matrix, the various dimensions of causation and effectuation are not highly correlated with each other. In addition, as might be expected with a formative construct, the various sub-dimensions of effectuation are not highly correlated. While most relationships between causation and the dimensions of effectuation are modest, we will investigate the significant relationship between causation and the pre-commitments dimension more thoroughly through robust evidence obtained from the exploratory and confirmatory factor analysis.

4.3.3.2. Exploratory and confirmatory factor analysis. We repeated the same exploratory factor analysis procedures we used in Study One with the data in Study Two. The results, presented in Table 2, provide initial support for the dimensionality of the items created to measure the effectuation sub-dimensions and the causation construct. Because factor loadings have substantially larger standard errors than typical correlations, we use the conservative guidelines specified by Hair et al. (2006) when determining the statistical power of factor loadings. Using a .05 significance level, a power level of 80%, and standard errors assumed to be twice those of correlation coefficients, guidelines (Hair et al., 2006) indicate that factor loadings should be .40 or greater. Our items all have loadings of .45 or higher, indicating adequate statistical power.

To further analyze this dimensionality, we conducted confirmatory factor analysis (CFA) using AMOS. Confirmatory factor analysis is especially well suited for determining the factor structure of latent variables because it provides a basis for comparing models with alternative factor structures (Kline, 1998). Note that we carry out these analyses in order to help evaluate causation and the reflective lower-level sub-components of effectuation. Following the recommendations of Byrne (2001), we used a multi-step approach to test the factor structure. First, we ran CFA models for several dimensional configurations and calculated fit statistics which helped guide inferences regarding the absolute fit between the model and the data. Second, we determined the relative fit of the models through model-to-model comparisons.

We then proceeded to analyze the formative nature of the effectuation construct. The theoretical model proposed by Sarasvathy (2001) indicates that causation and effectuation represent two alternative approaches to new venture creation. Our initial study indicates that effectuation consists of several sub-dimensions and we have argued that effectuation is a formative construct made up of conceptually different sub-dimensions (experimentation, affordable loss, flexibility, and pre-commitments). Following the guidelines set out in the growing literature on formative measures (e.g. Diamantopoulos, 2008; MacKenzie et al., 2005), we tested this structure by analyzing both first-order and second-order models. In first-order models, the measures are assumed to be direct indicators of each latent variable. We analyzed first-order models for a single factor, two factors (causation and effectuation), and five factors (causation, experimentation, affordable loss, flexibility, and pre-commitments).

In the second-order models, we modeled experimentation, affordable loss, flexibility, and pre-commitments as indicators of second-order sub-dimensions of effectuation. We conducted these second-order analyses for the single factor and two-factor models. It is important to point out that we do this in order to help determine whether the sub-components of effectuation are empirically distinct from causation. As effectuation is a formative construct, it is not necessary for the first-order measures to

Table 3
Means, standard deviations, reliabilities, and correlations — Study Two.

Variable	Mean	SD	α	1	2	3	4	5
1.Causation	3.32	.85	.78					
2.Flexibility	3.98	.64	.70	.214*				
3.Experimentation	2.55	.94	.78	.063	.126			
4.Affordable loss	3.48	1.11	.85	.203*	.306*	−.065		
5.Pre-commitments	3.04	.88	.62	.387*	.111	−.030	.029	
6.Uncertainty	2.84	.69	.66	−.245*	.042	.305*	−.092	−.188*

$N = 196$.
* $p < .01$.

empirically "fit" together. Nevertheless, we ran a two-factor model in which the pre-commitment construct loaded on both the causation and effectuation second-order constructs. This dual loading practice, alluded to by Kline (1998) and demonstrated in the literature (e.g. Pellegrini and Scandura, 2005), is appropriate for theoretical and empirical reasons. Theoretically, there is some degree of conceptual overlap between the pre-commitments dimension and the causation construct. For example, while obtaining pre-commitments reduces the uncertainty faced by the entrepreneur (effectuation) it is also an activity that can be applied successfully in causation processes in which the involved parties have been clearly identified, the product/service offerings have been specified, and the nature of the relationship has been defined. This suggests that pre-commitments may be part of both processes, rather than distinguishing between them. Empirically, the pre-commitment dimension was significantly related to the causation construct. Because the correlation is moderate in size, as well as statistically significant, it is important to include in the CFA a model that investigates its shared nature.

A major concern with employing formative measures is in establishing and identifying an appropriate model for the measures. By definition, the causal effect of the lower-order variables on the formative measures is under-identified (Diamantopoulos et al., 2008). Subsequently, providing satisfactory empirical evidence that a formative model exists is difficult (Bollen and Lennox, 1991). Indeed, there are two common criticisms of the use of formative measures. The first is that authors use the term formative as an excuse to simply include measures that do not seem to fit together (Bollen and Lennox, 1991; Diamantopoulos and Winklhofer, 2001). The second is that in order to estimate a formative measurement model, further information must be added to any structural model (e.g. Howell et al., 2007). However, by adding additional information, such as with a MIMIC (multiple indicators multiple causes) model, the empirical results can be seen as difficult to interpret (Jarvis et al., 2003) and one could argue that "all that is needed is a set of distinct components as decided by expert judgment" (Rossiter, 2002: 315). As such, the conceptual evaluation of whether a construct is formative or reflective may be just as important, if not more so, than the empirical one (Diamantopoulos and Siguaw, 2006; Diamantopoulos and Winklhofer, 2001).

Despite these potential drawbacks, we followed the suggestions of MacKenzie et al. (2005) to evaluate the fit of the effectuation construct by designing a MIMIC model in LISREL. We constrained one of the sub-dimensions of effectuation to be equal to one and then added two theoretically appropriate reflective indicators to the model. We then evaluated the fit of the entire model consisting of three reflective constructs (experimentation, affordable loss, and flexibility) and two single indicators. The items "We started by looking at what and who we knew and thought of different things we could try" and "We adapted accessible resources to our own specific needs" were chosen as they neatly and summarily capture the spirit of Sarasvathy's (2001) original reasoning on effectuation. As such, these adequately provide theoretical support for effectuation and the nature of its sub-components.

It is important to note that the only appropriate statistical tests to conduct concerning formative indices are related to validity (e.g. Diamantopoulos and Winklhofer, 2001). It is not appropriate to evaluate the internal consistency of a formative index as each component of the index is there for a theoretical reason. Removing one component may adversely affect the overall meaning of the latent construct (Jarvis et al., 2003) and thus restrict the domain of the construct (Churchill, 1979). In fact, a potentially larger problem for a formative measure is multicollinearity, because high correlations among indictors (or lower-level latent constructs) would suggest too much conceptual overlap and thus a non-parsimonious index (Diamantopoulos et al., 2008). In the case of effectuation, multicollinearity is not a problem as the highest correlations are 0.306 (between affordable loss and flexibility). Viewing all of our results together, we are confident in our treatment of effectuation as a higher-order formative construct made up of three lower-level reflective constructs and the shared construct of pre-commitments.

4.3.4. Results

We evaluated each model in terms of its absolute fit with the data using the chi-squared statistic and several fit indices. The chi-square gives an indicator of absolute fit, but is sensitive to degrees of freedom. The ratio of the chi-square statistic to the degrees of freedom provides a first goodness of fit metric, in which ratios less than two indicated good fit (Wheaton et al., 1977; Marsh and Hocevar, 1985). The normed fit index (NFI), the comparative fit index (CFI), and incremental fit index (IFI) also assess the fit of the model with less sensitivity to degrees of freedom. It is common for values greater than 0.9 to be considered an indication of acceptable model fit while values greater than .95 are viewed as representing good fit (Bentler, 1992). In addition, the root mean square error of approximation (RMSEA) is examined. Values of RMSEA between .10 and .08 represent a mediocre fit, between .08 and .05 represent a reasonable fit, and below .05 represent a good fit (Browne and Cudeck, 1993; Byrne, 2001; MacCallum et al., 1996). The confirmatory factor analysis results are shown in Table 4. The first step in evaluating the models is to determine their absolute fit. Reviewing the chi-square to degrees of freedom ratio, IFI, NFI, CFI, and RMSEA fit statistics reveals that, among first-order models, both the single factor and two-factor models fit the data poorly, while the five-factor model provided a reasonable fit for the data (χ^2(125 degrees of freedom) = 195.30, for a ratio of 1.56, IFI = .929, CFI = .926, RMSEA = .054). Among second-order models, the one-factor model (χ^2 with129 degrees of freedom = 284.25, for a ratio of 2.20, IFI = .843, CFI = .836, RMSEA = .079) fits the data modestly. The two-factor model fits the data reasonably well (χ^2 with 128 degrees of freedom = 212.47 for a ratio of 1.66, IFI = .915, CFI = .911, RMSEA = .058). The two-factor model with dual loading pre-commitments (χ^2 with 127 degrees of freedom = 198.42 for a ratio of 1.56, IFI = .928, CFI = .925, RMSEA = .054) represents an improvement over the base two-factor model.

The second step in the CFA process is to evaluate the models with a reasonably good absolute fit to determine which has the best relative fit. The chi-squared difference test indicated that the difference in fit between the second-order one-factor and two-factor models is statistically significant ($\chi^2 = 71.78$, $p < .01$), supporting the distinction between causation and effectuation as distinct second-order factors. In addition, comparing the two-factor model with pre-commitments loading on both causation and effectuation produced a significant difference ($\chi^2 = 14.05$, $p < .01$), suggesting that the pre-commitment actions would best be

Table 4
Confirmatory factor analysis fit statistics for alternative models.

Model	X^2	*df*	IFI	NFI	CFI	RMSEA
Null model	1117.3	153	–	–	–	–
First-order models						
1-factor: first order	752.66	135	.371	.326	.347	.153
2-factor: first order	634.13	134	.491	.432	.471	.138
5-factor: first order	195.30	125	.929	.825	.926	.054
Second-order models						
1-factor:	284.25	129	.843	.746	.836	.079
2-factor:	212.47	128	.915	.810	.911	.058
2-factor: pre-commitments dual loading	198.42	127	.928	.822	.925	.054

Note: IFI = incremental fit index, NFI = normed fit index, CFI = comparative fit index, RMSEA = root mean square error of approximation.

viewed as pertaining to both causation and effectuation processes. Comparing this second-order two-factor model with dual loading pre-commitments to the first-order five-factor model does not yield a statistically significant difference ($\chi^2 = 3.12$, $p < .21$). This suggests that while three models provide a reasonable fit for the data, the second-order two-factor model with dual loading pre-commitments and the first-order five-factor models provide a relatively better fit. To note is that the NFI falls slightly below ideal levels for both first and second-order models.

In addition, the MIMIC model in which we constrained affordable loss to be equal to one and then added experimentation and flexibility to the model showed excellent fit (χ^2 with 5 degrees of freedom = 6.4 for a ratio of 1.28, $df = 5$, IFI = .985, CFI = .984, NFI = .935, GFI = .987, RMSEA = .038), thus providing empirical support for our treatment of effectuation as a formative construct.

In all of the models causation processes are clearly distinguished from the set of practices collectively referred to by Sarasvathy as effectuation. However, the first-order model with causation, experimentation, affordable loss, flexibility, and pre-commitments as independent sub-constructs fits the data as well as the second-order model with causation and effectuation as a latent variable (represented by experimentation, affordable loss, and flexibility) with pre-commitments shared between the two constructs. Notwithstanding the apparent equality of the two models in explaining the observed data, there are two strong reasons to retain the effectuation label. First, the theoretical argument for effectuation as a process has been articulated persuasively by Sarasvathy (2001). Although the five-factor model may be seen as more parsimonious, rejecting effectuation as a latent variable when the data are consistent with it seems unwarranted. Second, it would likely be premature to conclude against a latent effectuation construct given the relative goodness of fit. This presents an opportunity for future research to further explicate the dimensionality of these important entrepreneurial processes.

Finally, to evaluate the predictive validity, we examine the correlations between uncertainty and our causation and effectuation measures. According to Sarasvathy (2001, 2008), the greater the uncertainty, the greater the likelihood that entrepreneurs will use effectuation processes. As seen in Table 3, uncertainty is negatively correlated with causation, and positively correlated with experimentation, lending general support for the predictive validity of the constructs.

5. Discussion

Sarasvathy's (2001) article utilized a grounded theory methodology to identify the constructs of causation and effectuation. The next step in the theory building process is the development of measures and testing the proposed relationships. Our research takes this next step, and in doing so makes four important contributions. First, using data from two field samples, we develop, refine, and provide validating information for measures of causation and effectuation. Second, we use these measures to test the dimensionality of the constructs and their distinctiveness as suggested by Sarasvathy (2001). Specifically, we show that causation is a uni-dimensional construct, but effectuation is a multidimensional formative construct. Third, we show that one dimension of effectuation (pre-commitments) is shared with causation and provide a theoretical rationale for why that is the case. Finally, we show that causation measures are negatively related to measures of uncertainty and the experimentation sub-dimension of effectuation is positively related to measures of uncertainty, in support of Sarasvathy's conceptualization of causation and effectuation.

5.1. Causation processes

In both studies, evidence supports the reliability and validity of our measure of causation processes. The internal consistency reliability of the measure, Cronbach's alpha, was .73 for the first study and .78 for the second study, indicating sufficient reliability for research purposes (Nunnally and Bernstein, 1994). In addition, in both studies, items representing the causation construct loaded cleanly onto the same factor, providing support for their convergent validity and did not load on non-target factors, providing evidence of discriminant validity. Finally, the confirmatory factor analysis also provides additional evidence in support of the construct validity (i.e., convergent and discriminant validity) of the causation construct. Thus, the evidence validates our causation measure as a reliable and valid indicator.

5.2. Effectuation processes

The measures of effectuation processes were also refined and developed. The original effectuation items in Study One did not load cleanly onto a single factor. Thus, we carefully re-read the theoretical work (Sarasvathy, 2001) and re-examined the effectuation construct. We recognized that our measures capture the conceptually different components of the (latent) effectuation process. Therefore, we proposed that effectuation is a formative construct composed of three independent sub-dimensions (experimentation, affordable loss, and flexibility), and one sub-dimension (pre-commitments) that is shared with causation. Our results in Study Two provide evidence that effectuation can be viewed as a formative construct made up of reflective sub-constructs (i.e. Type II formative construct). In showing this we provide evidence for the reliability and validity of the various sub-components of effectuation. This includes carrying out the 'traditional' statistical tests when operationalizing new measures.

With respect to measurement reliability, the coefficient alpha for each dimension, except pre-commitments ($\alpha = .62$), meets or exceeds the .70 referred to by Nunnally and Bernstein (1994) as being suitable for research purposes. Thus the combination of confirmatory factor analysis and scale analysis provides evidence that supports the reliability and validity of our measures. In summary, the literature using empirical tests to evaluate formative constructs is at a relatively early stage (e.g. Diamantopoulos and Siguaw, 2006). However, we conducted tests suggested to be appropriate in this literature. Our conceptual tests concerning the causal nature of the sub-constructs, their inter-changeability and co-variance, and potential antecedents showed that effectuation is more likely to be a formative rather than a reflective construct. We argue that each of the sub-components contributes a unique and important facet of effectuation.

Our research also provides an empirical test for the assertion that causation and effectuation represent distinct approaches that entrepreneurs take to new venture creation. This test is done by using a non-exploratory method. In effect, we tested whether the four factors we identified as part of effectuation (experimentation, affordable loss, flexibility, and pre-commitments) were best represented as four independent factors or as sub-components of a larger construct called effectuation. Our results indicate that experimentation, affordable loss, and flexibility are not part of causation, thus supporting a general conceptualization of effectuation.

5.3. Pre-commitments and alliances

We believe that we have developed robust scales for causation, experimentation, affordable loss, and flexibility. However, our pre-commitments scale is not as strong. Sarasvathy (2001) conceptualizes pre-commitments and strategic alliances as mechanisms that can be used to help control the future. The items included in this measure capture pre-commitments but not alliances. As a result, we carefully crafted some additional items and collected data from 40 more respondents from a broad cross-section of new businesses in a western U.S. state. The data collection procedure mirrored that followed in the first two studies. Specifically we sought to strengthen our measure of pre-commitments/alliances. To tie the new items to the old scale we included the two items from the old scale in the new scale.

1. We have used a substantial number of pre-commitments and agreements with customers, suppliers and other organizations and people.
2. We used pre-commitments from customers or suppliers as often as possible.

In addition we included four additional items. We did this while exercising care to not make them as broad as item 1 above.

1. Network contacts provided low cost resources.
2. By working closely with people/organizations external to our organization we have been able to greatly expand our capabilities.
3. We have focused on developing alliances with other people and organizations.
4. Our partnerships with outside organizations and people play a key role in our ability to provide our product/service.

Although our sample size was not adequate to run a full scale analysis, we used the items measuring alliances and pre-commitments and the scales measuring each of the other constructs (causation, experimentation, affordable loss, and flexibility) in a series of exploratory factor analyses. In all cases the individual and combined measures of sampling adequacy were adequate. There were clear distinctions between the pre-commitment/alliance items and the other measures of effectuation (experimentation, affordable loss, and flexibility). There is still evidence of double-loading when factored with the causation items. This provides additional evidence that pre-commitment/alliance is a shared component. The six pre-commitment/alliance items above are internally consistent with a coefficient alpha of .86.

Our empirical results indicate that pre-commitments/alliances appear to be used in both causation and effectuation processes. While it is possible the measures we developed do not adequately describe the variable as described by Sarasvathy, procedures to support content validity were followed and we believe that the measures have strong conceptual grounding in her work. What does it mean that pre-commitments are important to both processes? Sarasvathy contends "effectuation emphasizes strategic alliances and pre-commitments from stakeholders as a way to reduce and/or eliminate uncertainty and to erect entry barriers" (2001: 252). Certainly in the effectuation process pre-commitments are important because they allow firms to test markets without owning all the resources to do so (Hitt et al., 2001). Yet, alliances have also been an integral part of the strategic management literature which emphasizes a rational, logical approach to decision making. We suggest that pre-commitments may be important for both processes albeit for different reasons. The effectuator uses pre-commitments to reduce uncertainty,

minimize cost of experimentation, and maintain flexibility. The causation approach uses pre-commitments and alliances as a way to acquire essential resources and implement plans.

Finally, we provide early evidence of predictive validity. The fact that uncertainty is negatively associated with causation and positively associated with the experimentation component of effectuation provides evidence in support of Sarasvathy's theoretical description of the constructs.

6. Limitations and implications for future research

Notwithstanding these useful contributions, our study has limitations, many of which suggest areas for future research. Beyond replication, this research could provide a starting point for at least seven different research streams.

First, additional research is needed to make sure we have identified the most relevant sub-components of effectuation. While we followed Sarasvathy's descriptions, identified four key defining concepts, and measured them empirically, the development of all potential constructs may be an iterative process involving multiple empirical examinations. Thus, future research might examine whether there are other dimensions of effectuation that distinguish this process from causation processes. Also, even though our findings present substantial support for the constructs, future research is necessary to continue to examine and refine the measures we established in this research. This is common as rarely are original operationalizations of impactful and complex concepts 'perfect.' For instance, the potential for a social desirability bias for the affordable loss sub-concept is one aspect that may be refined over time. We acknowledge this, but also believe that we provide a strong starting point for future empirical research concerning measurements of causation and effectuation processes.

Second, we provide empirical support for treating effectuation as a formative construct using a MIMIC model as described by following Jarvis et al. (2003). We also used a panel of expert judges to determine the validity of the measures. While we chose two items for the MIMIC model that were theoretically appropriate, other studies have found it beneficial to include outcome variables as a gauge of the nomological validity of the formative construct (MacKenzie et al., 2005). For instance, Ruiz et al. (2008) employ two reflective constructs (Satisfaction and Repurchase Intentions) to help establish their Service Value index by showing that higher levels of Service Value will lead to higher Satisfaction and Repurchase Intentions. As of yet, our understanding of effectuation has not led us to develop reliable measures that will help accurately predict (performance) outcomes. We do, once again, underline the importance of the theoretical tests of the appropriateness of using formative indices.

Third, as far as we can discern, the finding by Wiltbank et al. (2009) that business angels who employ a control (versus prediction) logic have fewer failures is the first study to find differential performance outcomes from using effectuation. This limitation in our study provides many possibilities for future studies to analyze outcome measures both to provide confirming evidence that supports effectuation as a formative construct, and also to expand our understanding of how the new venture development process influences the outcomes. Thus, does the choice of causation or effectuation processes impact subsequent venture development outcomes such as the amount of time required to get a venture up and running or eventual performance? Sarasvathy (2001) suggests that causation and effectuation do not predict performance. However, when experimentation and effectuation are used under high levels of uncertainty, it would be reasonable to expect greater variance in performance.

Fourth, besides uncertainty, are there other antecedents to the choice between causation and effectuation processes? Previous research in entrepreneurship has shown that the entrepreneur's human capital (e.g. entrepreneurial experience, education) and cognition (e.g. entrepreneurial alertness, entrepreneurial scripts, counterfactual thinking, cognitive style, heuristics) (Dew et al., 2009; Mitchell et al., 2007) may have an impact on the choice of process. Future research should explore the relationship between these determinants and causation and effectuation processes. For example, research suggests that entrepreneurship experience leads to faster decision making (Forbes, 2005); thus habitual entrepreneurs may be more likely to follow an effectuation process (Dew et al., 2009). The research into entrepreneurial scripts (Mitchell et al., 2000) suggests that entrepreneurs use heuristic-based logic allows them to make significant leaps in their thinking; thus perhaps skipping several of the "logical" steps in the new venture creation process.

Fifth, our data were collected on the basis of retrospective accounts of single informants. Such reports could be subject to post hoc rationalizations; however, we suggest the likelihood of retrospective bias (March and Sutton, 1997) to be low because the information we gleaned regarding the new venture creation process deals with an event of significant importance (Akerlof and Yellen, 1985) and occurs infrequently (Sudman and Bradburn, 1973). Both of these factors tend to improve the accuracy of recalled information. In addition, we sought to use firms that are relatively new to the market and where the respondent was the driving force behind the venture. However, we acknowledge that retrospective bias could be a confounding factor and suggest that future research apply a longitudinal or experimental design, and also capturing the views of others intimately involved in the process. The longitudinal research could be designed to follow entrepreneurs from nascency through the process of new venture creation thereby alleviating the retrospective bias.

Sixth, our sample was drawn from four, four-digit SIC codes. The diversity among the industry groups suggests some generalizability of these constructs. However, more broad-based samples will be required to more fully address the issue of generalizability.

Finally, the model of validation used in this research might provide a pattern to re-examine other constructs that have been used in the entrepreneurship literature. For example, many studies have attempted to conceptualize and test the measures associated with entrepreneurial orientation. The current literature states that entrepreneurial orientation consists of three to five measures that vary independently (Richard et al., 2004). However, because proactiveness is conceptually and empirically different than risk-taking and innovativeness etc., entrepreneurial orientation might be better treated as a formative, rather than a

reflective construct. Recent studies in the marketing literature (e.g. Jarvis et al., 2003; Ruiz et al., 2008) have begun to review the appropriateness of treating some of their important concepts as formative indices. The field of entrepreneurship should also consider this endeavor.

6.1. Implications for practice

We believe these findings have important implications for practicing and aspiring entrepreneurs. First, they represent a merging of the academic study of entrepreneurship and practice that should facilitate mutual understanding and learning. For example, in conversation about causation and effectuation processes with one very successful entrepreneur, she stated that she was glad there was a name for what she had been doing. This research, therefore, helps to make academic research more credible and useful to practitioners.

Second, these results suggest that entrepreneurs may benefit from examining the approach they use in venture creation, and the assumptions that underlie those approaches. Causation approaches view the world as a place where markets exist and firms seek out opportunities, within the markets in which they compete, to perpetuate themselves. Effectuation approaches view the world as a place where firms plant, nurture, and harvest in markets that are artificially created by themselves and the actions of other firms. Perhaps entrepreneurs that tend to engage solely in causation-related activities would benefit from considering effectuation-related activities and vice-versa. Such an expanded repertoire of activities would likely help entrepreneurs in their choice of activities and find greater compatibility and understanding with partners who prefer to work using a different approach.

Finally, this research suggests that the obtaining of pre-commitments is an activity that is consistent with both entrepreneurial approaches. This suggests that entrepreneurs seeking common ground for a potential venture may find pre-commitment-related activities to be a point of agreement, even if they tend to use different approaches to new venture creation. Conversely, if pre-commitments are the only activities on which entrepreneurial partners or teams have agreed, this research suggests additional activities that should also be considered before relationships are solidified.

7. Conclusion

In summary, causation and effectuation have been proposed as alternative new venture creation processes used by entrepreneurs. An acknowledgement of these different processes suggests that entrepreneurs and firms not only need to invent better ways to predict the future, they also need to develop devices that allow them to create as well as adapt to their environment (Dew and Sarasvathy, 2001). An understanding that both causation and effectuation processes are legitimate ways to initiate and grow businesses provides entrepreneurs and potential entrepreneurs with a more comprehensive and well-developed set of skills that can be used to initiate viable ventures. The current study has provided researchers and practitioners important tools for measuring the phenomena that are at the core of this understanding. In addition, we have provided evidence that these measures can be reliably used and that while the dimensionality of these processes is generally consistent with Sarasvathy (2001) it may be more accurate to consider the obtaining of pre-commitments as playing a role in both the causation and effectuation processes. These measures and findings should provide an important ramp for the launching of additional research.

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