

On the cognitive microfoundations of effectual design: the Situated Function–Behavior–Structure framework

By: Amir Emami, Mark D. Packard, [Dianne H.B. Welsh](#)

Emami, A., Packard, M. and Welsh, D. (2020), "On the cognitive microfoundations of effectual design: the Situated Function–Behavior–Structure framework", *Management Decision*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/MD-10-2019-1479>

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Abstract:

Purpose

The purpose of this article is to extend effectuation theory at the front end by building cognitive foundations for the effectual design process.

Design/methodology/approach

We adopt an integrative conceptual approach drawing on design cognition theory to explain entrepreneurial cognition.

Findings

We find a significant gap in the entrepreneurial cognition literature with respect to effectuation processes. We thus integrate the Situated Function–Behavior–Structure framework from design theory to elaborate on the cognitive processes of effectuation, specifically with regard to the opportunity development process. This framework describes the cognitive subprocesses by which entrepreneurs means and ends are cyclically (re)formulated over time until a viable “opportunity” emerges, and the venture is formalized, or else, the entrepreneur abandons the venture and exits.”

Practical implications

Unravelling this entrepreneurial design process may facilitate more appropriate and effective design work by entrepreneurs, leading to more successful product designs. It also should facilitate the development of better design techniques and instruction.

Originality/value

This research contributes to new cognitive foundations for effectuation theory and entrepreneurial process research. It better explains how means are transformed into valuable goods over time through an iterative reconsideration of means-ends frameworks. This theoretical

elaboration will expectedly facilitate additional research into the iterative cognitive processes of design and enable more formulaic design thinking.

Keywords: decision management | entrepreneurial opportunity | effectuation | opportunity formation | situated function-behavior-structure

Article:

“Where you are when you do what you do matters. – Gero and Kannengiesser (2004, p. 376)”

Introduction

How do entrepreneurs develop “new venture ideas” (Davidsson, 2015) or “opportunities” (Shane, 2003) within the effectuation process? And how do they determine when they have ascertained a viable opportunity within this design process amid turbulent environments where markets and customers are continually changing? Effectuation theory posits an alternative decision logic to traditional managerial “causation” logic (i.e. a strategic planning approach, cf. Mintzberg, 1978), which entails choosing an imagined opportunity (end) and organizing activities (means) effectively to economically exploit the opportunity (Shane, 2003). It instead “take[s] a set of means as given and focus[es] on selecting between possible effects that can be created with that set of means” (Sarasvathy, 2001, p. 245). In essence, the effectuation approach flips the entrepreneurial decision logic in order to mitigate risk, navigate uncertainty, and facilitate action.

However, while effectuation theory has grown significantly in recent years (Perry et al., 2012; Read et al., 2009; Welter and Kim, 2018), its cognitive microfoundations remain underdeveloped. “Microfoundations” refer to the (often individual-level) underpinnings of socioeconomic phenomena (Barney and Felin, 2013), such as entrepreneurial opportunities, from or through which such phenomena emerge. There has been some recent work in developing microfoundations for effectuation theory, but these efforts have so far focused on the determination between a causal or effectual decision logic (An et al., 2020; Berends et al., 2014; Fisher, 2012; Frese et al., 2020; Kerr and Coviello, 2020; Packard and Clark, 2020; Reymen et al., 2015; Smolka et al., 2018) or the differences between novice and expert entrepreneurs (Dew et al., 2018). One promising avenue of microfoundational exploration connects effectuation theory to design science (Sarasvathy, 2003; Sarasvathy et al., 2008), which advocates a forward-looking, prescriptive approach to science. For example, Zhang and Van Burg (2020) analogize genetic algorithms to the effectuation process so as to elaborate pragmatic design principles for opportunity development. However, while analogizing is often helpful, such metaphoric “as-if” theorizing can mislead if the true underlying mechanisms are not understood (Berg and Girgerenzer, 2010). In short, effectuation theory is still lacking the cognitive underpinnings necessary to understand and theoretically elaborate robust design principles for effectual entrepreneurs toward developing new venture ideas over time.

The intended contribution of this article, then, is in setting forth initial cognitive microfoundations for effectuation theory. Specifically, we address three foundational questions: (1) how do effectual entrepreneurs develop imagined “opportunities” in dynamic market

environments?; (2) how do effectual processes unfold in objectifying entrepreneurial opportunities as artifacts?; and (3) when does a perceived opportunity become “ripe” for exploitation? To answer these questions, we integrate Gero and Kannengiesser's (2004, 2007) situated function–behavior–structure (SFBS) cognitive ontology into the effectuation cycle. The SFBS framework contributes to effectuation theory by elaborating on the cognitive processes by which entrepreneurial goals and opportunities are designed and objectified. Although our focus here is on the opportunity perception and refinement process, the SFBS can also help explain what leads individuals to act entrepreneurially, which decision logics they employ, and why they choose the exploitation paths that they do.

Literature review

Entrepreneurship is a fundamental economic process, the source of economic growth (Schumpeter, 1942). Entrepreneurs exercise control over owned resources, producing from them surpluses that might be traded for profit under conditions of uncertainty (Dana, 1995; Foss and Klein, 2012). This holds for the owner-manager of a small business (who is simply seeking to further personal goals), as well as the growth-oriented innovator-entrepreneur (Dana, 1995; Ramadani et al., 2016). Yet, while entrepreneurs (may) have different goals and intentions, most contemporary research on entrepreneurial cognition posits a general discovery process as originating all such undertakings. These cognitive models, we contend, are not yet sufficiently variable to capture the heterogeneity in venture origination processes. A more elaborate cognitive process model is needed. Here we briefly review the entrepreneurial cognition literature with respect to opportunity recognition (or new venture ideation) before developing our elaborated model.

Entrepreneurial opportunity and decision making

The bulk of entrepreneurial cognition research has come from within the dominant “opportunity discovery” paradigm, which is, in effectuation theoretic language, a causation process. Since Shane and Venkataraman's (2000) seminal article, a growing body of entrepreneurship research has examined the nature and validity of the “entrepreneurial opportunity” construct (e.g. Alvarez and Barney, 2010). Typically, the entrepreneurial cognition literature depicts this opportunity construct as the connection of supply with unmet demand, whether both the supply and demand already exist (but are not yet “aware” of each other) or whether one or both have yet to be created (Sarasvathy et al., 2003). The essence of entrepreneurship is the uncertain pursuit of new value (Emami et al., 2020a; Packard, 2017) toward creating a better (i.e. higher-valued) future (see Dimov, 2017). Value creation, then, underpins the entrepreneurial process (Bruyat and Julien, 2001; Hills et al., 2005).

Following others (e.g. Casson, 2000; Davidsson, 2015; Klein, 2008; Packard, 2017), we define “entrepreneurial opportunity” as a metaphor for a situation in which an entrepreneur imagines that, by reallocating owned (or ownable) resources into new combinations, s/he might provide new value to consumers, and thereby, generate revenues that are greater than the cost of production. Accordingly, an entrepreneurial opportunity is comprised of five key criteria. First, it is a situation (or a collection of situations (Davidsson, 2015)). As McMullen (2015, p. 659) notes, “all opportunities are situations, but not all situations are opportunities”. Second, it is a

mental image, and not a belief (as beliefs are firmer than images), about the future. Third, it is uncertain: because it is new, there is no prior or specific record that would warrant perfect or certain expectation (McMullen and Dimov, 2013). Fourth, it contains an incentive for its pursuit, which is often, directly or indirectly, a solution to pain, problem, or need (Foss and Klein, 2012). Finally, its exploitation requires an investment, with expectations of future profits or gains (Davidsson, 2015; Klein, 2008), defined broadly.

Entrepreneurial cognition research has examined the cognitive subprocesses underpinning each of these five elements or criteria. First, the “situations” in which opportunities are recognized, discovered, or created are “socially situated” (Mitchell et al., 2011), i.e. observable only within social networks (De Carolis and Saporito, 2006). Dimov (2007) further points to the “insight situation,” where divergent experience promotes divergent learning, and thus, better opportunity recognition (Corbett, 2005).

Second, researchers have examined the cognitive processes of imagination through which new solutions to recognized problems are designed. The bulk of this literature examines the knowledge foundations of opportunity identification (e.g. Grégoire et al., 2010; Grégoire and Shepherd, 2012; Shane, 2000). Some of this literature examines the entrepreneur’s abilities toward empathy (Emami et al., 2020b; Khalid and Sekiguchi, 2018; McMullen, 2010, 2015; Prandelli et al., 2016). Still, others focus on the cognitive underpinnings of creativity per se (e.g. Ward, 2004).

Third, uncertainty is a key, and even, defining element of entrepreneurial judgment (Foss and Klein, 2012; Townsend et al., 2018). Traditionally, uncertainty-bearing has been explored as a personality trait (e.g. Kihlstrom and Laffont, 1979; Van Praag and Cramer, 2001). However, some have examined it as a necessary response (Bergmann and Sternberg, 2007; Gohmann and Fernandez, 2014), although necessity entrepreneurs appear to be more risk-averse on average (Block et al., 2015). The cognitive processes underlying such uncertainty-bearing comprise extensive decision-making literature (Kahneman, 2011). However, some have criticized the prevailing decision-making literature as artificial “as if” theory, modeling the general effects of uncertainty, but leaving the actual, underlying cognitive processes unattended to (Berg and Girgerenzer, 2010; Felin et al., 2017). Thus, much more research is needed to unpack the real cognitive processes through which uncertainty is borne.

Fourth, some entrepreneurial cognition research has explored the motivation or intentionality of entrepreneurs. (Bird, 1988; Krueger, 2017). As McCaffrey (2014) observes, Kirzner's (1973) theory of opportunity discovery is underpinned by a theory of entrepreneurial incentives, which motivate entrepreneurial intent. Entrepreneurial intent has been defined as “a self-acknowledged conviction by a person that they intend to set up a new business venture and consciously plan to do so at some point in the future” (Thompson, 2009: p. 676). Most of the cognitive research on entrepreneurial intent is premised either upon Ajzen's (1991) theory of planned behavior or on Shapero and Sokol's (1982; cf. Krueger, 1993) entrepreneurial event model, or both (Schlaegel and Keonig, 2014).

The last criterion, investment, entails the commitment of decision-making or judgment, which has perhaps gained the most attention to date (see Shepherd et al., 2015 for a review). Such

investment includes a cognitive and personal commitment to the opportunity (Mitchell et al., 2008), the risky investment of personal (owned) resources (Foss and Klein, 2012), and the allocation of personal time and effort—of committing action—to the endeavor (McMullen, 2015). An action is a directed behavior resulting from a judgment under uncertainty (McMullen and Shepherd, 2006; Shepherd, 2015). The “entrepreneurial journey” (McMullen and Dimov, 2013) begins with such action and ends when entrepreneurial intent, and thus, entrepreneurial action is abandoned (Brown et al., 2018).

Recently, scholars have observed a critical problem in entrepreneurship theories, and especially those that have the “opportunity” as their core construct. While the entrepreneurial journey is a forward-looking process, entrepreneurship research is (or has been) backward-looking, waiting until certain outcomes (e.g. milestones) are reached before retrospectively theorizing about how they were reached (Dimov, 2011). Through this reverse engineering view (Lerner et al., 2018), the theorist can at best identify the decision chain and then explain it. However, research suggests that such decision reconstruction is highly fallible, even for those who made the decisions (Abatecola et al., 2018; Dimov, 2011). Details of the multiplicative decision tree are overlooked, forgotten, or misremembered. Yet, these details are often crucial to the paths that the entrepreneur navigated in the course of opportunity development.

As a result of this wicked problem, some have called for the abandoning of the opportunity construct altogether, which is prone to mislead (e.g. Davidsson, 2015; Foss and Klein, 2012, 2017; Klein, 2008). Others, however, defend the opportunity as a useful and important concept in entrepreneurship (e.g. Alvarez and Barney, 2020; Ramoglou and Tsang, 2016; Wood and McKinley, 2020). Our own intermediary stance within this debate is somewhat reconciliatory; we accept the existence of “entrepreneurial opportunities”, but redefine them as unmet consumer needs rather than the more classical definition as market imperfections. As unmet consumer needs, opportunities exist as a prospective value if and to the extent that an economical and effective solution to those needs can be generated. This reconceptualization offers, we think, not only a promising solution to entrepreneurship’s theoretic woes but also a more pragmatic and tangible concept for practitioners.

Effectuation theory

In contrast to the opportunity discovery and exploitation model that has dominated the early entrepreneurial cognition literature, Sarasvathy (2001, 2003) proposed an alternative cognition model, the theory of effectuation, based in Simon's (1969) work on problem-solving under uncertainty. According to effectuation, an entrepreneurial opportunity is formed out of ambiguous goals with an unpredictable future by controlling the resources at hand through a design process. When entrepreneurs create new ventures, they alter the markets in which they compete, forming new artifacts (or modifying existing ones) in time. Thus, the core premise of entrepreneurship is problem-solving (cf. Hsieh et al., 2007).

Causation describes the strategic planning approach to entrepreneurship, wherein the entrepreneur perceives an opportunity, gathers the required resources, and exploits it. In the effectuation cycle, however, entrepreneurs begin with who they are, what they know, and what they have—that is, their means are a function of their physical resources, identity, knowledge, and

networks. These resources change in value when they are transformed into something new (Sarasvathy and Dew, 2013).

Foundational effectuation research suggests that, while causation represents the traditional business mindset, entrepreneurial experience gravitates toward effectual logic (Dew et al., 2009, 2018; Sarasvathy, 2003). Because effectuation encompasses a non-causal approach to decision making, entrepreneurs do not necessarily start the entrepreneurial process from an initial opportunity evaluation but rather by assessing themselves (Dew et al., 2009). Entrepreneurs are, thus, considered not as actors who form opportunities and then act on them, but as agents who act experimentally and incrementally, with limited foresight, taking advantage of the means currently at hand. Effectual entrepreneurs remain flexible rather than rigid concerning goal setting, leverage unexpected contingencies as they arise, and engage in scenario planning (Sarasvathy, 2003).

In short, effectuation theory posits that one possible decision path through the entrepreneurial journey—purportedly one preferred by more experienced and expert entrepreneurs—is through carefully avoiding substantial risks and pursuing adaptive, emergent goals rather than predictive plans. Throughout this process, committed resources are recursively designed into evolving solutions to unmet consumer needs—that is, into evolving opportunities.

Relatively unexamined, however, are the cognitive mechanisms underlying such opportunity development processes within this effectuation process. There has been some limited work recently in this direction, which has included examinations of the role of social interaction processes (Kerr and Coviello, 2020) and of the cognitive differences between novices and experts (Dew et al., 2018). However, this research has not yet unpacked the cognitive processes underlying effectual resource adaptation, and the bulk of the entrepreneurial cognition literature has remained focused on forward-linear opportunity recognition and development processes as opposed to the circular, recursive opportunity design process described and advocated by effectuation theory. We address this gap by introducing the situated function–behavior–structure framework into effectuation theory, next.

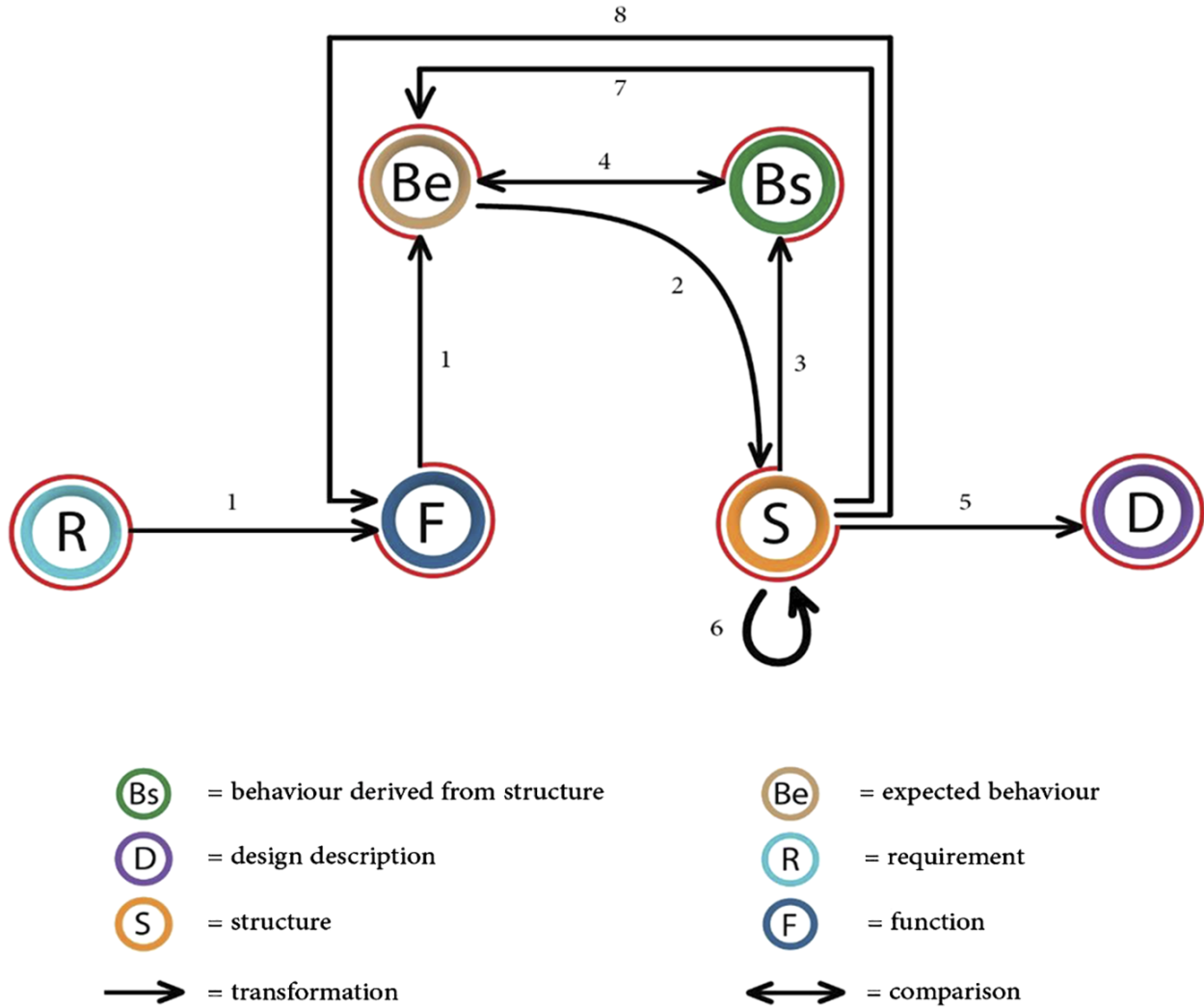
The situated function–behavior–structure framework

The situated function–behavior–structure (SFBS) framework (Gero, 1990; Gero and Kannengiesser, 2004, 2007) is a theory of cognitive processing through which ideas about things are translated into useful forms and functions. The process is “situated” in that it is embedded within and responsive to the contextualized human experience. This cognitive process, we argue, comprises the design process on which effectuation theory is founded.

The SFBS separates objects into three main ontological categories—function (F), behavior (B), and structure (S)—and two bridging constructs that connect the three ontological categories to the external environment—requirements (R), and description (D) (Figure 1). Function references the teleology or purpose of the design object. Behavior describes the attributes that can be derived from the design object’s structure and is subdivided into two subcategories: the desired and expected behavior (Be) and actual behavior afforded by structure (Bs). Structure, then, signifies the components of the design object and their relationships. Requirements are considerations

given by the user to the designer. Finally, description connotes a depiction of the design created by the designer.

Figure 1. The SFBS design ontology



Source(s): Adopted from Gero and Kannengiesser (2004)

The first three ontological divisions are interconnected: function is connected with behavior and behavior with structure. However, there is no innate relationship between function and structure. It is the process of design that creates structure and behavior (and its subclasses) from function.

The SFBS framework outlines eight key processes in designing (see Table 1, Figure 1). First, formulation generates an initial design state space by translating a recognized problem space into a set of goals or functions ($R \rightarrow F$), and these functions into desired behaviors ($F \rightarrow Be$). In other words, consumers' design requirements, as understood by the designer and expressed in function (F), are imagined to perform some expected behavior (Be) that would enable F. In

entrepreneurial terms, this means defining the problem to solve, the unmet consumer need or market inefficiency to address, and how it might be addressed.

Table 1. Stages of the FBS design process

Stage	Process	Definition
1	Formulation	$R \rightarrow F \rightarrow E_b$
2	Synthesis	$E_b \rightarrow S$
3	Analysis	$S \rightarrow B_s$
4	Evaluation	$E_b \leftrightarrow B_s$
5	Documentation	$S \rightarrow D$
6	Type 1 Reformulation	$S \rightarrow S'$
7	Type 2 Reformulation	$B_s \rightarrow E_b'; S' \rightarrow E_b'$
8	Type 3 Reformulation	$B_s \rightarrow F'; E_b' \rightarrow F'; F_e \rightarrow F'$

Second, synthesis generates structure based on behavioral expectations of the state space ($B_e \rightarrow S$). It is the creative process of transforming desired behaviors of means into “New Combinations” (Schumpeter, 1939) that would, expectedly, perform B_e , and thus, enable F . Synthesis is bounded by the entrepreneur’s affordance knowledge, their knowledge of the possible forms and functions, of their available means. For entrepreneurship, this process entails assessing the possibility of available (or potentially available) means to solve the determined problem, and to combine means as necessary to create a possible solution.

Third, the analysis stage comprises the interpretation and analysis of generated structure toward a more formal and synthesized understanding of structure-afforded behaviors ($S \rightarrow B_s$). Said differently, in this stage, the actor tests innovative structures to ascertain their real behaviors. In essence, the entrepreneur builds and tests a prototype to determine what it can really do.

Next, the evaluation stage compares and contrasts expected behaviors or affordances with the actual behaviors derived from the structure, as determined in the analysis stage ($B_e \leftrightarrow B_s$). Here, the entrepreneur evaluates and reassesses his/her expectations and the presently designed solution. To what extent does (or does not) the solution work? What other behaviors can be observed in the structure?

Fifth, documentation produces a standardized description of the structure’s design ($S \rightarrow D$), and if needed, its expected behavior and function. This documentation is intended primarily for the user (i.e. consumer) audience, so that the nature, purpose, and functionality—i.e. the value potential—of the newly designed structure might be understood. Consumers often need help and guidance when presented with an altogether new design to understand its intended purpose and proper use.

Reformulation processes

After this first iteration of the design process, it is highly likely that the evaluation results in an assessment that the value and viability of the original design are unacceptable. Thus, the design

process is recursive, involving three types of iterative reformulations: structural, behavioral, and functional. Notably, these reformulation processes proceed countercyclically to the design process.

First, type 1 (structural) reformulation reassesses and adjusts the structure state space ($S \rightarrow S'$). In other words, it revises the designed innovation according to the feedback mechanisms that point to structural/design flaws, resulting in ineffective Bs. This reformulation process is done within the same existing functional state space—that is, its revisions are still based on the entrepreneurs existing means.

Type 2 (behavior) reformulation modifies the behavior state space based on new information gained in the evaluation stage ($Bs \rightarrow Be'$) or from a revision to the structure in type 1 reformulation ($S' \rightarrow Be'$). Type 2 reformulation from type 1 reformulation would typically return the designer to the analysis stage of the SFBS process. For example, upon learning that her prototype did not work, an entrepreneur revises her design, forms new expectations, and builds a new prototype to test. Type 2 reformulation due to evaluation information typically results in type 1 or type 3 reformulation.

Type 3 (functional) reformulation modifies the function state space resulting in a reassessment of the problem set and goals of the entrepreneur. This reformulation may result from discoveries of previously unknown behaviors ($Bs \rightarrow F'$), from a type 2 reformulation of expected behavior ($Be' \rightarrow F'$), or simply from new experience or observation of some consumer need or market problem ($Fe \rightarrow F'$, where Fe is a newly experienced function). Most entrepreneurial revisions to the function state space are, likely, a result of new external information about market needs, whether directly experienced or otherwise learned. However, in accordance with effectuation theory, type 3 reformulation of the function state-space can also derive recursively from revised behavior state spaces, both actual (e.g. learning from a prototype) and expected (e.g. new, expected functionality of a new innovation idea). Thus, the function is not always or necessarily externally given, but can also become reimagined through internal, recursive reformulation processes.

These different types of reformulation indicate that the design world is dynamic and involves regular goal revisions and focus shifts. Additionally, the design process involves analyzing such changes in order to (re)evaluate current or potential new product ideas (Gero and Kannengiesser, 2007). Designing new structures can lead to a continuous reevaluation of the business idea, which keeps changing based on changing market perceptions, realities, and demands.

The SFBS framework is well suited to effectuation's design concept. Not only does it offer a cognition-focused theory of the design process, but it also elaborates on the processes of adaptation that are central to effectuation theory. Effectuation theory emphasizes the evolution of entrepreneurs' goals (type 3 reformulation) in conjunction with changes to their means through the creation and use of artifacts, but the underlying cognitive processes by which such reformulation occurs has so far been opaque. SFBS opens this black box, offering a solid foundation for understanding how concepts, artifacts, ideas, and plans recursively evolve in a cyclical "effectuation" process.

Situatedness within an environment

Entrepreneurship and environment are reciprocally related—entrepreneurs navigate, modify, and make better use of their environment over time (Marshall et al., 2019). Within entrepreneurial cognition literature, a primary purpose of developing cognitive models, especially process-oriented models, is to illustrate the dynamic interactions between environment, entrepreneur, and action (De Winnaar and Scholtz, 2019). This is because entrepreneurial behavior proceeds from manifold interactions between the dynamic environment and the entrepreneur’s mind (Grégoire et al., 2011), facilitating the experiential learning processes necessary to perceive and successfully exploit entrepreneurial opportunities (Corbett, 2005, 2007). Entrepreneurial firms are faced with hurdles, such as how to design and create products and services and to choose an appropriate organizational form for the development of new business opportunities. Davidsson (2015) argues that external conditions, such as changes in technology, demography, culture, human needs and wants, and institutional framework conditions (i.e. external enablers), are some of the main sources of new venture ideas, and can both leverage and hinder means as a responsive solution to unsatisfied needs in the market. As examples of leverage, the evolution of social media or the advances in the market have produced new business models and channels for value creation (Krombholz et al., 2012). On the other hand, an example of a hindering effect is regulatory authorities’ banning of rideshare companies to protect conventional taxi services. In some cities, these bans caused a shift in the existing business model to new forms that are no longer banned.

The “situatedness” of SFBS references the fact that designers’ knowledge is grounded in their experiences and interactions with the environment. In other words, the designer constructs, amends, and reimagines connections amongst the function, behavior, and structure of a design artifact through experience. Designing is, thus, as continual a process of innovation as is the human experience, involving the external, interpreted, and expected world.

The external world references mind-independent reality. Its ontological status as objective or mind-independent implies that it has imposing consequences on human experience, regardless of the designer’s perceptions of them. This external world is raw matter and its motion, meaningless except insofar as it is interpreted.

The interpreted world comprises reality as it is experienced. Conscious experience occurs through a filter of mental representation—what we perceive is a mental image generated from collected sensory impulses (Bennett et al., 1989). Such perception includes the function, behavior, and structure of all concepts, which give meaning to perceived matter in the external world. A table is simply a matter that has a certain structure, but that structured matter is given function and behavior in the concept of “table” that we attach to it. These concepts, by which the external world is given meaning and purpose, are created and refined through our experiential interactions with the external world, as explained by the SFBS framework.

Finally, the expected world is an imaginative realm, comprising reality as it expectedly will be, or could be, as a result of the designer’s actions within the current (perceived) state of the world, driven by purposes and hypotheses. It is comprised of mental simulation (Wells and Gavanski, 1989), of one’s “small world representation” of reality (Maitland and Sammartino, 2015) through

which causal inputs are logically played out to their outcomes. Again, this “small world” mental model of reality (Johnson-Laird, 1983) is continuously developed through SFBS processes.

Like most process-oriented models in the cognitive sciences, one’s interaction with the environment is an important part of SFBS (Gero and Kannengiesser, 2007). The SFBS framework involves a recursive, interactive process between decision making and feedback evaluation (cf. Packard et al., 2017). It is important for the designer to see what they are doing and adjust their decisions based on continual learning. Assessment of the process needs to take place in real time so that causal memory can be appropriately attached to the temporal experience, and thereby, facilitate artifact refinement. This is an important part of the memory process and involves recalling initial perceptions to see how they are changing, which enables reinterpretation.

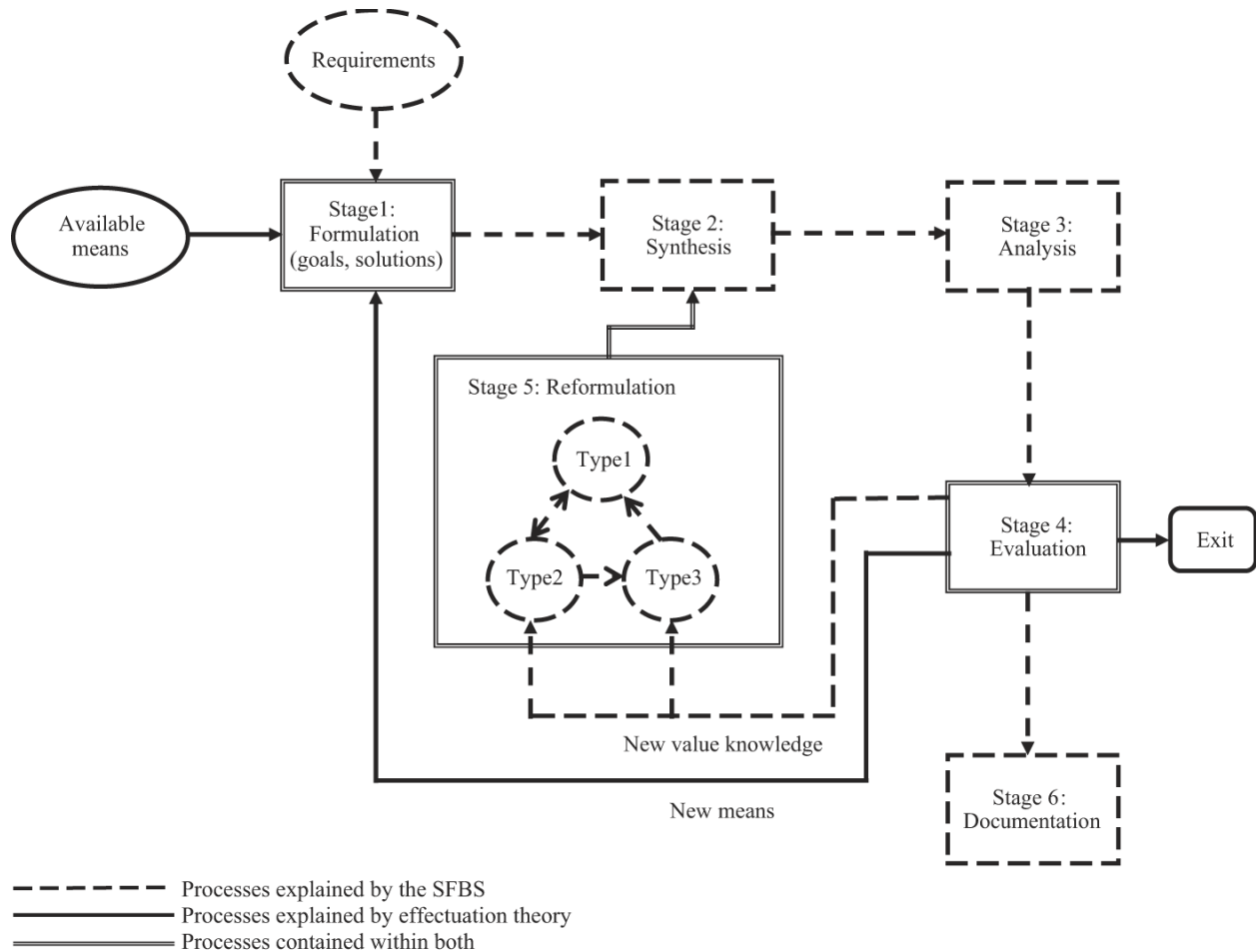
The external environment, as an enabler, can provide tools for a more effective transition from the actual means to the actual course of action for three reasons. First, as an initiator, the external world is comprised of real affordances that can be combined into technologies to meet unsatisfied needs, which continue to be discovered and created over time. Second, the institutional context reflects the external environment, within which entrepreneurs interact and learn in order to create and develop opportunity insights and turn expected value into actual value. Finally, observing changing consumer demands within the external environment lends critical insight and credence to opportunity beliefs.

This process of artifact design, as depicted by the SFBS, offers a useful, and we think, more descriptive cognitive process theory of product design and opportunity formation, as we shall elaborate next.

A Synthesized Model of SFBS and effectuation

Integrative conceptual approaches are useful strategies, applicable to research in small business and entrepreneurship as in these domains, and researchers need to uncover many complex and unknown elements in processes (Dana and Dana, 2005). The SFBS framework and effectuation theory are theoretically complementary, combining to elaborate our understanding of how behavior and resources impact the introduction of new opportunities. In this section, we outline a synthesized, hybrid model that incorporates aspects of the design process, as given by the SFBS framework, into the traditional effectuation process. The proposed model in Figure 2 depicts how the effectuation cycle can form an entrepreneurial opportunity through the recursive process of SFBS design. The process elements signified by double-lines indicate those stages of the process common between modern effectuation theory and the SFBS. The solid lines are aspects of the process singular to effectuation theory. The dotted lines are singular to the SFBS. Together, the process takes on a much more complete picture.

Figure 2. Synthesized model of SFBS and effectuation



Stage 1: formulation

At the start of the entrepreneurial journey, Stage 1, the entrepreneur begins by assessing and evaluating his/her available means: who am I, what do I know, and whom do I know? This process is an evaluation of the structure of available means. This evaluation leads to an initial consideration of the available behaviors or affordances of controlled means—what can I do with my means?

Concurrently, the entrepreneur perceives the external environment signals and insights, signifying the required features and constraints of the functional design. These external signals can be changes in technologies, consumer adoption patterns, the global regulatory environment, or unmet needs (Davidsson, 2015). Thus, the perceived external enablers may constrain or augment the recognized possible behaviors of the means structure, or what can be done.

Together, these initial assessment of means and their affordances—what can I do with my means—in conjunction with external signals of consumer needs and wants, facilitate an initial formulation of a value proposition—a goal in the language of effectuation. Formulation involves the integration of internal and external information into a cogent target function—what is the target goal for those means, the problem that the entrepreneur wants to solve—based on their perception of what consumers want. This function is constrained by those means, but also enabled by them. For example, research suggests that creative constraints can, often, increase creativity, whereas unrestricted option sets can impede perceiving any good options (Moreau and Dahl, 2005; Schwartz, 2004). The effective and economical provision of this function is, expectedly, the road to entrepreneurial success.

Stage 2: synthesis

In Stage 2, the synthesis stage, the function or goal formulated in Stage 1 motivates and directs the innovator's creativity toward imaginatively designing a plausible solution, the initial opportunity, or a new venture idea. In essence, the innovator's creative imagination is engaged in creatively combining the known structures and behaviors of available means, synthesizing these combined aspects to create a new structure and behavior that would, expectedly, perform the function intended. This process is consistent with the notion of constructive memory, which is adapted from the SFBS framework.

Stage 3: analysis

Once such a solution is imagined, the entrepreneur enters the fourth stage of the SFBS, analysis. Here, beliefs, morals, ethics, conventions, and social and cultural matters are engaged in an interpretive process to translate the initial opportunity idea into its expected value (Dimov, 2007). To the extent that it is not user entrepreneurship, this valuation process must be empathic (Kier and McMullen, 2018).

At this stage, the entrepreneur needs to know the structure of the end components because it helps to determine the design outcome (value). For example, in cases where the desired function or end is to sell second-hand goods via a retail website, the structure question is what the dashboards of the website might look like. The dashboard's structural design determines how easily the customer can find, see, and buy the desired goods from the website, playing a primary role in its overall value analysis. Thus, a prototype is (or ought to be) devised in this stage, minimum viable product (MVP) in the language of the lean startup method (Ries, 2011).

Stage 4: evaluation

Now that the entrepreneur has formulated a value proposition and developed the MVP, it is time to test it in the fourth stage: an evaluation. The opportunity idea—the formulated function, behavior, and structure of combined resources into a specific value proposition—is presented to potential stakeholders, such as investors, customers, suppliers, etc. for their evaluation. According to the effectuation theory, this interaction can have three different outcomes. First, it can result in market approval, instigating launch (Stage 6). This is unlikely in the initial cycles of the effectuation process but may occur after several iterations. Second, it can instigate

commitments from these potential stakeholders, which commitments include the collection or, at least, the promise of additional resources. Finally, it can offer new insights into the actual market value of the value proposition.

Stage 5: reformulation

The second and third of these possible outcomes from the evaluation stage prompt reformulation processes. First, new stakeholder commitments provide new means with which to create new, and potentially, more valuable structures. Thus, gathering new stakeholder commitments instigates a type 1 reformulation process. This, in turn, can lead to a type 2 reformulation, as reviewed previously.

Second, the testing a value proposition in the market provides new information about what consumers actually value, and how close or far the entrepreneur's present value proposition addresses those real valuations. This does not mean that the entrepreneur learns from the market precisely what it truly values, which valuations have proven rather latent, tacit, and ineffable. Instead, market testing merely entails assessing value propositions for their superiority to prevailing options, which can lead to some new valuable insights. If the entrepreneur's value proposition tests poorly, this can instigate a reformulation cycle, depending on whether it is the structure, behavior, or the function that is the evaluated cause of dissatisfaction.

This stage is cyclical, repeating until the reformulation processes come to a new equilibrium, resulting in a new opportunity idea (or, perhaps, exit). Thus, the cycle returns to Stage 2 for a new synthesis, analysis and prototyping, and evaluation.

Stage 6: documentation and launch

Once this process is completed, the entrepreneur has built enough opportunity confidence (Davidsson, 2015; Dimov, 2010) about his/her value proposition to the target market, having mitigated and managed uncertainty sufficiently, to launch (Stage 5). While the scope of our research here does not include the many processes involved in product or venture launch, this stage also contains within it the documentation stage of the SFBS framework, which is worthy of brief elaboration due to its inclusion within the SFBS.

Documentation involves generating a sales pitch to consumers such that they can easily observe, comprehend, and thereby prefer the value proposition that the entrepreneur has developed. This documented pitch constitutes, in essence, describing the structure, behavior, and function of the value proposition in its final form (at the time of launch) in terms that the target audience can grasp. Finally, this pitch—the documentation—is disseminated as widely as possible in various ways, through various communication channels, given marketing budget constraints. Only those customers that receive and understand this documentation, the pitch, can assess its value to themselves, which process will determine the extent of the value proposition's diffusion and market penetration (Rogers, 2003).

In conclusion, the SFBS process maps onto the effectuation cycle extremely well, and the synthesis of the process models offers various new insights into the cognitive processes by which

effectuation unfolds. Consistent with the effectuation logic, this hybrid framework implies that the formation of opportunities is contingent upon knowledge dissemination, learning, and transformation. It embeds the designing mind within an evolutionary process, interactive with its environment and others, whereby the function, behavior, and structure of the entrepreneurs' means undergo rapid and radical reconceptualization in a recursive design process until the project is abandoned, or hopefully, an acceptable market solution is developed and launched.

Implications and future studies

Effectuation has curried considerable attention among entrepreneurship scholars. Its core premise is the dynamic process by which economic artifacts (e.g. products, organizations, and markets) emerge. Entrepreneurship scholars seek to “study the emergence of new organizations” (Lichtenstein, 2011, p. 471) and take “process [as their] fundamental object of enquiry” (McMullen and Dimov, 2013, p. 1,505; Gupta et al., 2016). However, to date, most of the effectuation literature remains high-level, examining the performance implications of effectual versus causal decision logics (e.g. An et al., 2020; Berends et al., 2014; Fischer, 2012; Frese et al., 2020; Packard and Clark, 2020; Reymen et al., 2015; Smolka et al., 2018) while largely overlooking the microfoundational mechanisms of such emergence processes. As a result, we continue to lack a sound theoretical basis for many of the theorized mechanisms of effectuation theory (Arend et al., 2015; Welter et al., 2016).

We have here proffered the SFBS ontology as a cognitive framework suitable to providing these microfoundational mechanisms in order to explain how effectuation occurs, i.e. how new venture ideas are generated and developed through effectual processes and how and when they are exploited. The SFBS framework involves a recursive and interactive process of design, consistent with effectuation. In the course of our conceptual model development (Figure 2), we have opened the black box of design processes for entrepreneurship scholarship and unfolded the sequence of activities in opportunity development.

Educator and practitioner implications

The emerging “entrepreneurship and a demand science” perspective is explicitly and intentionally practitioner-oriented, pushing science toward developing prescriptive theories and tools rather than mere descriptive accounts. By linking the SFBS ontology to effectuation theory, and thereby, laying a foundation for understanding how to develop and exploit a perceived opportunity, we significantly advance these design science endeavors.

An important aspect of this model is the interaction of the entrepreneur's mind with the ever-changing social structures by which the world is understood—the internal with the external. Entrepreneurship does not take place in a vacuum but through the actions of individual entrepreneurs within social systems (Dimov, 2017) in the face of uncertainty (McMullen and Dimov, 2013). This interaction is two-sided—the entrepreneur learns and reformulates ideas based on the changing interpretive environment and consumer learning processes (Emami et al., 2020b), and the entrepreneur, through design processes, can alter social understanding and create or alter social beliefs. Thus, consumers learn what to want and instruct entrepreneurs what to

produce, but they also learn what to want from entrepreneurs who design new and innovative solutions for consumers' consideration.

Our process model outlines how these evolutionary design processes occur, and thus, offers guidance to entrepreneurs and educators in navigating the process. For example, the insights of reformulation are particularly pertinent to entrepreneurship practitioners. The value and use of the entrepreneur's means are not or should not be predefined and fixed but are malleable and open to reformulation. Entrepreneurs that have limited means can achieve better outcomes through greater open-mindedness to the possibilities that their means could afford. Means reformulation is connected to, and often driven by, behavioral and functional reformulation—the creative use of resources can be augmented by reconsidering one's goals and actions. Such reformulation processes are enabled by counterfactual imaginative processes: “what if” ideation. By better explaining and advocating such processes, educators can, perhaps, better guide entrepreneurs toward more novel and exciting ideas.

Implications for future study

As entrepreneurship research turns increasingly process-theoretic (Gupta et al., 2016), this research offers key cognitive foundations for the field's advancement. This article, in essence, rescues the opportunity construct from very valid criticisms by reconstruing it as an evolving and subjective design concept rather than an objective entity or propensity. Furthermore, it addresses criticisms of effectuation theory, extending it at the front end toward a better understanding of how initial opportunity ideas arise, and elaborate the cognitive underpinnings of the effectual cycle to explain how those ideas evolve over time.

Future research should empirically test the proposed model, including the moderating role of entrepreneurial ecosystems on the entrepreneur's means and the reformulation of function, behavior, and structure over time. In particular, we think the SFBS framework offers great potential to further elaborate specific principles and activities within the effectuation process, such as “affordable loss” and “bird-in-the-hand”. It may also certainly be employed in unraveling causation logics, and perhaps, more fully and carefully distinguishing them from effectuation logics.

Finally, recent research has pursued human cognition process influencing the design process and decision to engage in entrepreneurial action, including and especially cognitive abnormalities, such as impulsivity (Wiklund et al., 2018), behavioral disinhibition (Lerner, 2016), and attention deficit hyperactivity disorder (Wiklund et al., 2016). While, unlike our own approach, this research stream considers entrepreneurial action in the absence of “reasoned judgment” (Wiklund, 2019), future research should examine such “unreasoned” cognitive processes within the context of the SFBS framework to see how and to what extent such abnormalities follow or diverge from the here-theorized process of entrepreneurial cognition. What are the cognitive processes of impulsive or ADHD actors that facilitate a greater likelihood of reaching Stage 6, i.e. deciding to launch?

Conclusion

Entrepreneurship is value-centric and dynamic. It is a rational process in pursuit of new value creation (Brown et al., 2018). Entrepreneurs gain opportunity insights from the environment to modify concept and the expected value of their product. The environment is a facilitator, as well as the context within which the entrepreneur is proactive and innovative in the marketplace. This article contributes to our understanding of entrepreneurial opportunity development by focusing on the design and cognition processes behind the entrepreneurs' judgment and action. The proposed integrative framework is not without limitations. Since entrepreneurial artifacts include a vast array of mediums, it might be challenging to apply the proposed framework to abstract, intangible, or futuristic concepts. However, this article suggests that a design-based effectuation process can help further explain the entrepreneurial process toward a more holistic understanding of value creation. Therefore, it provides a useful theoretical framework, based on effectuation and design theory, for future research and offers valuable insights for entrepreneurship practice and design science.

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Further reading

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About the authors

Amir Emami is Assistant Professor of Entrepreneurship and Strategy in the Faculty of Management at Kharazmi University. His research focuses on entrepreneurial decision-making, learning, and action.

Mark D. Packard is Assistant Professor at the University of Nevada, Reno. He received his PhD from the University of Missouri in 2016. His research spans entrepreneurial judgment, uncertainty, the theory of entrepreneurship, and philosophy of science.

Dianne H.B. Welsh is the Hayes Distinguished Professor of Entrepreneurship and Founding Director of the Entrepreneurship Programs at The University of North Carolina Greensboro. She has previously founded two entrepreneurship programs/centers and has held three endowed professorships. In 2015, Dianne was the Fulbright-Hall Distinguished Chair in Entrepreneurship for Central Europe. Dianne is a recognized scholar in family business, international entrepreneurship, women-owned businesses and franchising and has authored seven books and over 150 publications. Her books include Creative Cross-Disciplinary Entrepreneurship, Global Entrepreneurship, and case Studies in Global Entrepreneurship. She was a Presidential Appointee to the USAF Academy. In 2019, she won the North Carolina Board of Governors Teaching Award, and the Family Firm Institute's Hollander Award for lifetime achievements.