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Advancing Strategic Entrepreneurship Research: The Role of Complexity Science in Shifting the Paradigm

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Five areas are identified wherein more development might enhance the current model of strategic entrepreneurship (SE): exploration–exploitation, opportunity, newness, micro–macro interaction, and dynamics. Complexity science is presented as an alternative theoretical lens for addressing these issues, and enhancing the potential of SE in a world characterized by fluctuations, irreversibility, nonlinearity, and instabilities. Using this lens, a rearticulation of SE is proposed that centers on the notion of an opportunity space and a paradigm built around forms, flows, and functions. SE's domain consists of a complex set of phenomena that cannot be neatly bundled according to disciplinary boundaries.

Introduction

> *We are not good at thinking movement. Our instinctive skills favor the fixed and static, the separate and the self-contained. Taxonomies, hierarchies, systems and structure represent the instinctive vocabulary of institutionalized thought in its determined subordinating of flux, movement, change and transformation (Chia, 1999, p. 128).*

Breakthrough ideas often occur when concepts from one field are brought into new, unfamiliar territory (Johansson, 2006). In what Johansson refers to as "the Intersection," established perspectives clash and combine with insights from other disciplines and cultures, potentially resulting in an explosion of new paradigms and path-breaking innovation. The present article is about the intersection of the disciplines of entrepreneurship and strategy.

The pioneers who introduced "strategic entrepreneurship" (SE) are academic luminaries with a strong record of intellectual contributions to both disciplines. In less than a decade since coining the term, they have published articles in leading journals, edited a scholarly research compendium, organized international conferences, and launched an academic journal devoted to SE. Yet, in spite of this progress, much is not understood

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regarding SE, and potential gaps exist in terms of its conceptualization. As such, it becomes less clear whether this hybrid called strategic entrepreneurship is a subfield within the entrepreneurship discipline, a subset of strategic management or corporate entrepreneurship, or a separate domain. In fact, some suggest that SE represents a benign takeover of entrepreneurship by strategic management (Baker & Pollock, 2007).

Although intuitively appealing, the case for the SE construct is not as clear-cut as proponents portray. We believe the SE domain can be advanced by treating the current fusion of strategy and entrepreneurship as a set of contested ideas rather than a settled issue. In this article, we propose ways to extend the paradigm by building on the established SE research. Our approach centers on critical components endemic to entrepreneurship, but not sufficiently accommodated by SE at present. These components demonstrate properties that are inherently complex, dynamic, nonlinear, seemingly random, and that interact across multiple levels of analysis. Such properties challenge the current manner in which SE is conceptualized, including underlying assumptions, and the dominant theoretical perspectives and methodologies. Complexity science is introduced as an alternative theoretical lens through which to view SE. We examine the ontological and epistemic limits of current perspectives and bring together a more nuanced account of a reality that resembles a complex system with its associated asymmetries, disproportional cause–effect relationships, distributed interaction patterns, temporal dynamics, unpredictable outcomes, and emergent structures (Kauffman, 1993). We argue that SE is more than a conjunction or interface between strategy and entrepreneurship, and conclude with observations on how an expanded perspective on SE creates openings for fruitful scholarly exploration.

Strategic Entrepreneurship: The Need for Conceptual Clarity

Strategic management is concerned with activities undertaken to achieve competitive advantage and earn above-average returns. It is seen by some as providing the context for entrepreneurial actions (Ireland, Hitt, Camp, & Sexton, 2001), where the latter is about the identification and exploitation of opportunities. The marriage of the two in the form of "strategic entrepreneurship" produces entrepreneurial action with a strategic perspective and strategic action with an entrepreneurial mindset (Hitt, Ireland, Camp, & Sexton, 2001). SE is defined as "the integration of entrepreneurial (i.e., opportunity-seeking behavior) and strategic (advantage-seeking behavior) perspectives in developing and taking actions designed to create wealth" (Hitt et al., p. 481). Its basic precepts, which have received relatively little critique, begin with the firm as the basic unit of analysis, and include a need for simultaneous opportunity-seeking and advantage-seeking behaviors in order for firms to maximize wealth (Ireland et al.). These behaviors are seen as complementary, which facilitates their integration, and the goal is to achieve a balance between the two. Achieving balance requires an entrepreneurial mindset, entrepreneurial leadership, and an entrepreneurial culture (Ireland, Hitt, & Sirmon, 2003). These inputs enable a firm to strategically manage resources in ways that facilitate simultaneous pursuit of opportunity- and advantage-seeking behaviors.

Despite its exciting potential, SE suffers from problems of conceptual clarity. Is SE a framework, model, theory, paradigm, concept, or a simple point of interface? The founders, in using the term "hybrid," clearly intended more than a merger or interface between two disciplines, suggesting something new was being created (Ireland et al., 2003). At the same time, SE does not constitute a new theory of strategy or entrepreneurship. Separately, it has been argued that SE is needed because no commonly accepted and

well-developed paradigm exists for research in entrepreneurship, and SE can provide this paradigm (Hitt et al., 2001). A paradigm includes shared assumptions, concepts, and methods that constitute a way of viewing reality (Kuhn, 1970). To date, no such world-view has emerged. Yet another perspective is that SE is a concept (Ireland et al., 2001), one that captures the need for simultaneous entrepreneurial and strategic action in firms of all types if they are to create wealth.

Another challenge with this new domain is that its boundaries or parameters remain largely unspecified. Hence, literally any existing work in entrepreneurship that includes actions by a firm that are strategic (e.g., building a network, interacting with a venture capital firm, investing in development of an entrepreneurial orientation) can be construed as SE. The six original domains of SE proposed by Ireland et al. (2001) have more recently morphed into ten topic areas that are the editorial focus of the new *Strategic Entrepreneurship Journal*. Beyond the topic "strategy versus entrepreneurship," the areas of focus are all traditionally associated with the entrepreneurship discipline (e.g., behavioral characteristics of entrepreneurial activity, economic growth, and entrepreneurship). In this manner, SE becomes an umbrella term to capture a broad swath of existing work in entrepreneurship. Meanwhile, most articles published to date under the guise of SE fail to address the vexing issues that surround the basic precepts outlined by the founders of this new arena.

The issue of boundaries also leads to confusion over terms. Recent years have seen considerable work at the interface between entrepreneurship and strategy (e.g., Meyer & Heppard, 2000). As a result, new research domains have appeared including corporate entrepreneurship (Sharma & Chrisman, 1999), corporate venturing (Burgelman & Grove, 2007), and entrepreneurial strategy (Eisenhardt, Brown, & Neck, 2000). All of these domains address entrepreneurial behaviors that are strategic, yet their definitional differences are subject to debate, and the relationships among them remain unspecified. Thus the SE construct rests on a number of assumptions which have yet to be tested. Chief among these is the notion that a balanced emphasis on opportunity-seeking and advantage-seeking activity is required in order to maximize firm wealth, and that such a balance can be managerially assessed and controlled. Further, it is assumed that opportunity- and advantage-seeking behaviors are inherently complementary, or can be made such, which under-emphasizes the potential trade-offs between the two in a dynamic environment.

It is also important to ask where, how, and in what form does innovation (and by implication, entrepreneurship) occur in SE? Does it take place inside the firm, through alliances and in networks, or perhaps other nonmarket, nonhierarchical modes? Does it occur from the top-down or the bottom-up, from the inside-out or the outside-in? Is it a function of entrepreneurial teams, visionary individuals, entrepreneurial mindsets or more collective action? Does it always result in creative destruction (Schumpeter, 1934)? Answering these not-so-simple questions requires that one traverse a wide variety of literatures—a difficult challenge in the limited space of a journal article. And yet, these questions lie at the heart of SE.

In an effort to touch on all important aspects, yet with brevity foremost in mind, we adopt an approach based on Nelson and Winter's (1982) notion of "appreciative theorizing," wherein theory, research, concepts, and conceptualizations from different sources are brought together in addressing a problem generally viewed as important. Specifically, we address the loci and interrelationships of entrepreneurship and innovation in SE. We seek a parsimonious set of concepts for analyzing the problems associated with uncertainty, change, and complexity in contemporary strategic decision-making contexts. While complexity science is highlighted, our purpose is not to critically appraise existing

theories or to build upon others—it is more generally delineated as elaborating on the constructs associated with the current model of SE.

Deconstructing SE: What Is Missing?

While the notion that organizations can excel by more successfully integrating strategy and entrepreneurship is intuitively appealing, the realities of how opportunity-seeking and advantage-seeking behaviors relate to one another are more complex than allowed for in the current SE conceptualization. The issue is less one of determining the result when constructs from two disciplines are combined, and more one of describing and explaining phenomena that occur from multiple dynamics. The danger is that SE becomes too reductionist or overly holistic in examining disparate entities and their respective behaviors in a single framework. Regardless of the theoretical lens employed, such reductionist approaches have generated limited progress and contradictory empirical results (Sirmon, Hitt, & Ireland, 2007).

In particular, five areas wherein we believe more development might be needed are: (1) the antagonistic nature of exploration and exploitation, (2) the ambiguous nature of entrepreneurship and its opportunities, (3) the transformative nature of novelty, (4) the multifaceted nature of multilevel dynamics, and (5) the process nature of change. These elements are magnified in a pluralistic world that is increasingly complex, ambiguous, hyperturbulent, and hyperinterconnected (Wiggins & Ruefli, 2005).

The Antagonistic Nature of Exploration and Exploitation

SE has been conceptualized as a value-creating union in which a balance is sought between exploration and exploitation (Ireland et al., 2003). March (1991) explains that what is known is thought to be stable and can be exploited through activities such as refinement, efficiency, selection, and implementation; what is unknown is awaiting discovery through exploration activities such as search, variation, experimentation, and discovery. Ireland et al. build upon March's work, explaining that established firms need to be ambidextrous or just entrepreneurial enough. However, the notion of dialectics as the resolution of supposed opposites (e.g., exploration and exploitation) ignores the underlying complexities and dynamics that are actually taking place.

We believe it is problematic to associate entrepreneurship only with opportunity seeking (exploration) and strategic management only with advantage seeking (exploitation). Although the roles of strategy in entrepreneurship and entrepreneurship in strategy are undeniably important considerations in their respective fields, their combined impact cannot be conceptualized simply as a fusion. While it is necessary to consider two different types of activities in SE—those that are entrepreneurial and others that are strategic—it is also important to separate activities in the "seeking" stage from those in the "doing" stage. Just as entrepreneurship consists of *both* exploration and exploitation, so do innovation, knowledge creation, value creation, and other constructs that use March's (1991) exploration–exploitation framework as a foundation. However, for each of these, the unit of analysis, relevant variables, processes, and outcomes are different. The "seeking" process (or exploration) in entrepreneurial activities is followed by the decision to exploit opportunities (Choi & Shepherd, 2004), which is not the same as the exploitation process associated with strategic activities (Brown & Eisenhardt, 1997). Stated differently, the entrepreneurship in opportunity discovery differs from the entrepreneurship in opportunity exploitation.

But this raises another question: what is innovation (newness) and how is it different from entrepreneurship in SE? The confluence of entrepreneurship and innovation (newness) needs to be examined from two perspectives: (1) what is the exploration–exploitation framework in innovation? and (2) what is the exploration–exploitation framework in entrepreneurship? According to Schumpeter (1934, p. 66), "in general it is not the owner of stage-coaches who builds railways." New combinations are typically embedded in new firms, which generally do not arise out of the old ones but start producing beside them. Major discontinuities provide evidence that new opportunities have been discovered. Schumpeter associates creative (as opposed to adaptive) response in innovation with irreversibility, irreducibility, unpredictability, and uncertainty, all characteristics of a complex system. Availability of new opportunities leads to opportunity-seeking behavior by managers who assume that "instead of seeing only changes the entrepreneur has wrought, we must focus on the opportunities that were waiting to be grasped by the entrepreneur" (Kirzner, 1973, p. 119), while other entrepreneurs enter existing markets, and still others create new opportunities (Sarasvathy, 2001). The entrepreneurship of exploration is not the same as the entrepreneurship of exploitation, and these processes differ fundamentally from the dual nature of March's (1991) framework. Further, firms match strategy making (micro level) with strategic dynamics (macro level) to exploit existing core business opportunities or explore potential new growth opportunities (Burgelman & Grove, 2007). Thus, despite apparent similarities, entrepreneurship cannot be viewed merely as an opportunity-seeking activity.

While it seems logical to minimize risks by seeking some sort of trade-off or balance between exploitation and exploration efforts, Zott and Amit (2007) report that balance between efficiency-centered (exploitation) and novelty-centered (exploration) elements of a business model may be counterproductive. Eisenhardt (2000, p. 703) explains:

> Paradox is the simultaneous existence of two inconsistent states, such as between innovation and efficiency, collaboration and competition, or new and old. Rather than compromising between the two in some sort of Goldilocks fantasy, vibrant organizations, groups and individuals change by simultaneously holding the two states. This duality of coexisting tensions creates an edge of chaos, not a bland halfway point between one extreme and the other. The management of this duality hinges on exploring the tension in a creative way that captures both extremes, thereby capitalizing on the inherent pluralism within the duality . . . Because of this, conceptions of change as smooth, linear and planned vanish . . . Formal, rational logic cannot deal with paradox.

The Ambiguous Nature of Entrepreneurship and Its Opportunities

Hitt et al. (2001) suggest that innovation is the middle ground for strategic management and entrepreneurship. In this view the various interfaces between entrepreneurship and strategic management revolve around the firm's role in innovation activities based on an entrepreneurial mindset (Hitt et al.), its entrepreneurial orientation (Covin & Slevin, 1991), the dominant logic (Meyer & Heppard, 2000), and entrepreneurial resources "defined as the propensity of an individual to behave creatively, act with foresight, use intuition, and be alert to new opportunities" (Mosakowski, 1998).

SE fails to capture the complexities surrounding the opportunity–entrepreneur nexus. Shane and Venkataraman (2000, p. 220; emphasis added) posit that

> To have entrepreneurship, *you must first have entrepreneurial opportunities*. Entrepreneurial opportunities are those situations in which new goods, services, raw materials, and organization methods can be introduced and sold at greater than their cost

of production (Casson, 1982). Although recognition of opportunities is a subjective process, the opportunities themselves are objective phenomena that are not known to all parties at all times. For example, the discovery of the telephone created new opportunities for communication, whether or not people discovered those opportunities.

In their opinion, opportunities (1) arise in an idiosyncratic manner as a result of errors and omissions of others that cause surpluses and shortages (Casson, 1982), or (2) are the result of technological, political, regulatory, sociodemographic, perceptual, and other unexpected changes in the environment. This perspective is overly constraining, and reflects two contrasting ontological and epistemological positions (McMullen & Shepherd, 2006). Scholars holding a positivist/realist position argue that an opportunity is a pre-existing objective reality independent of the actions of entrepreneurs. The alternate interpretive/social constructionist position holds that entrepreneurial opportunities emerge. According to Sarasvathy (2001) opportunities are always in the making, as entrepreneurs tend to behave as though the opportunity is a result of their action rather than a precursor to it. Thus, the entrepreneur plays one of three roles: opportunity scout, arbitrageur, or assembler of available resources.

Similarly, ambiguity surrounds entrepreneurship itself. In the strategy literature, entrepreneurship has an instrumental role related to creativity, or is defined in terms of innovative outcomes. Conner (1991, pp. 133–134) suggests that "discerning appropriate inputs is ultimately a matter of entrepreneurial vision and intuition; the creative act underlying such vision is a subject that so far has not been a central focus of resource-based theory development." Mosakowski (1998) defines entrepreneurship in terms of novel competitive outcomes that set a new standard for competition in an industry's relevant domains. She suggests that these outcomes capture the relationship between entrepreneurship and the Schumpeterian process of creative destruction. Schumpeter (1942) in turn believes the function of entrepreneurs is to reform or revolutionize the pattern of production. Knight (1921) alternatively describes the entrepreneur's roles as (1) exercising responsible control while; (2) securing the owners of productive services against uncertainty and fluctuation in their earnings.

The Transformative Nature of Innovation

Central to entrepreneurship are the concepts of newness and novelty (Shane & Venkataraman, 2000). Newness ranges from minor variations (incremental innovation) to radical change (discontinuous innovation) (Christensen, 1997). As currently conceptualized, SE embraces this incremental-discontinuous continuum. Consistent with its general emphasis on balance, the current perspective suggests that firms should seek to offset efforts directed toward radical innovation against those devoted toward more incremental advances. Yet, this perspective understates the true nature of innovation and novelty, especially as the focus moves away from incremental advances and toward discontinuities.

No consensus exists regarding the origin of newness or its qualities. Importantly, all that is "new" is not necessarily also "novel." The word "novel" is used liberally by scholars, but not always correctly. Novelty implies something original—it is the intense form of newness—that is, it is new *and* different, often in unusual, striking, or highly inventive ways. Schumpeter (1934) explains that his five types of "new combinations" result in discontinuity only when demonstrating high degrees of novelty. Previously undiscovered work by Schumpeter (2005) reinforces a distinction between newness that

results in growth (incremental change) and novelty associated with entrepreneurial development (a discontinuity from the steady state). Development involves a transition from one vector norm to another, where the transition cannot be decomposed into infinitesimal steps. Such discontinuity appears because of the emergence of novel phenomena. Contrary to Winter's (2006) view on the role of routines in producing novelty, Schumpeter (2005, p. 117) doubted that any evolutionary theory could explain novelty because

> it always fails when it comes to the inaccessibility and indeterminacy of novelty and of the leap, even more so when such a theory of descent acknowledges the leap and names it, e.g., sport or mutation. It always runs into logical limits, or in other words, the fact that our logic is a logic of the adaptation process which can only deny or dismiss development. And precisely that explains what remains unsatisfactory about the matter, as can easily be seen.

While acknowledging the entrepreneur's role as change agent, Schumpeter (2005) argues entrepreneurial behavior alone cannot explain novelty; novelty evades deterministic explanation.

Novelty poses vexing problems for organizations. Discontinuities represent significant departures from the status quo, often reflecting a lack of coherence with what is known in an industry or market. Firms pursuing discontinuous innovation create new competitive space, produce entirely new forms of customer value, and reshape or destroy existing industries. Such innovation is organic, emergent, resists planning, and can morph into unpredictable forms (Christensen & Raynor, 2003). It requires a strategic perspective that treats innovation as a dynamic process with qualitative characteristics emerging over time, often years (Sanders, 2007). Further, the organic nature of innovation can have profound internal effects, fundamentally changing the organization, its business model, and its identity (Zott & Amit, 2007).

All of this places unique demands on a company. Organizations have struggled to develop the kinds of internal environments and structures that can produce radical innovations (Sharma & Chrisman, 1999). The assumption is that even minor discontinuities threaten the mainstream organization, and management must create alternative structures (and networks) to discover and exploit them. At the same time, experiments with new venture divisions and various *ad hoc* structures have produced generally unsatisfactory results, while the evidence suggests that established companies are generally not adroit at developing and successfully implementing radical innovations (Burgelman & Grove, 2007).

The emergence of novelty cannot be explained with the mechanistic, computational, and representational means relied upon by scholars with current causal models (e.g., Shane & Venkataraman, 2000). For a model or account (e.g., the resource-based view) to explain why newness regularly emerges, in addition to allowing for complexity, it must allow for dynamic behavior (Pettigrew, Woodman, & Cameron, 2001). The resource-based view (RBV) has serious shortcomings in this regard as it emphasizes causal and hierarchical effects, remaining largely antithetical to a dynamic, continuous conception of change over time (Sirmon et al., 2007).

The Multifaceted Nature of Multilevel Dynamics

SE is also limited by its reliance on a predominantly firm-level perspective. In a recent special issue of *Organization Science*, the editors argue that innovation is inherently a multilevel phenomenon, and urge researchers to begin treating it as such (Gupta, Tesluk, & Taylor, 2007). Rothaermel and Hess (2007) demonstrate how unilevel research misses

the important impact of heterogeneity at the (interdependent) levels of analysis left out of the research. Further, there are levels within levels that must be transgressed, such as a nested hierarchy within a market or a company (Hitt, Beamish, Jackson, & Mathieu, 2007) and interactive effects at the individual, firm, and network levels (Rothaermel & Hess). Variables at any level can affect the extent and type of innovation at a given level (Gupta et al.).

Multiple levels are inherent in Schumpeter's (1942) work linking micro-level entrepreneurial behavior into a macroeconomic model through the concept of "creative destruction." Similarly, Covin and Slevin (1991) treat the entrepreneur or the venture as micro-level phenomena, while approaching opportunities at a macro level. However, the literature on entrepreneurship, strategic management, and innovation is typically split between two unconnected levels of analysis, with an emphasis on either macro- or micro-level theories, whereas Dopfer, Foster, and Potts (2004) introduce a micro-meso-macro framework formulated around rules for evolutionary economics. Volberda and Lewin (2003) use selection and adaption theories to illustrate an emphasis on two levels of analyses that do not intersect. These authors have developed a useful summary of the theories with their respective levels of analysis in an "adaptation-selection space," as shown in Figure 1. These theories, all of which are relevant to SE, are grouped into (1) firm-level theories that explain heterogeneity (e.g., the resource-based view, behavioral theory of the firm), (2) meso-level theories linking the firm with its institutional and competitive environment (e.g., transaction cost economics, evolutionary economics), and (3) theories involving interaction between exogenous discontinuities originating in the social, political, and technological environments and change at the institutional environment, industry, and firm levels (e.g., contingency theory, resource dependence theory, population ecology). As such, the micro–macro dichotomy is overly limiting, as is the tendency to ignore the temporal interplay among levels of analysis.

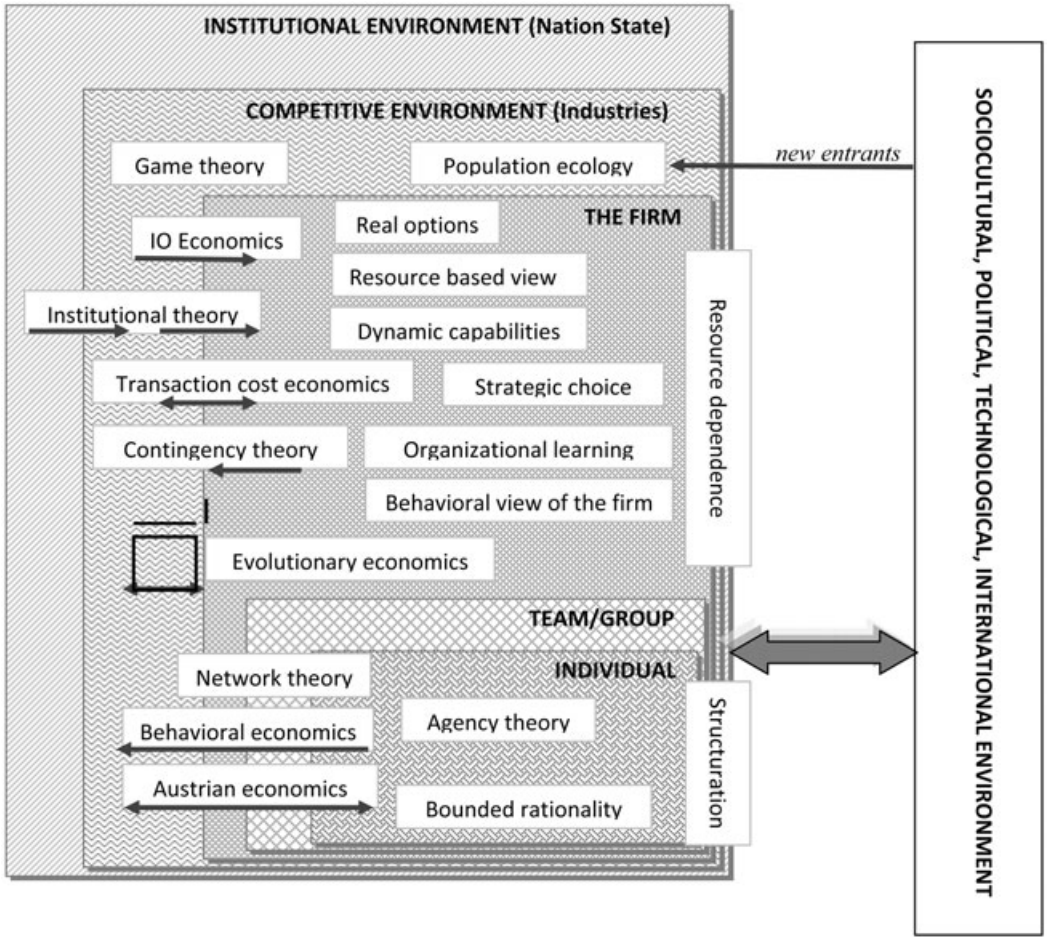
The Process Nature of Change

Change is the final component that is central to, yet underdeveloped in, the current conceptualization of SE. Novelty results from change, but novelty also serves to change industries, markets, and organizations. In short, change is central—sometimes evolutionary and sometimes revolutionary—and multiple orders of change are often involved. Within organizations, novelty helps explain punctuated equilibrium models that posit extended periods of incremental and adaptive change punctuated by brief periods of discontinuous, radical transformation (Pettigrew et al., 2001). Hence, both chaos and non linearity become features of organizational development.

Designed during a period of relative tranquility, the dominant paradigms in organizational theory are based on stability seeking and uncertainty avoidance through structure and processes. These paradigms are inadequate for global, hypercompetitive environments (Ilinitch, D'Aveni, & Lewin, 1996). Corporate decision makers have tried various strategic alternatives such as structural change (from traditional hierarchical efficiency-oriented forms to flatter, decentralized, and flexible designs) (Whittington, Pettigrew, Peck, Fenton, & Conyon, 1999), process change (e.g., interactive processes and horizontal flows that promote coadaptive exploitation) (Brown & Eisenhardt, 1998), and changing boundaries (Prahalad & Hamel, 1990). The systemic and dynamic nature of both the organization and its rapidly changing competitive environment require systemic change rather than piecemeal efforts (Van de Ven & Poole, 2005). Whereas organization theorists treat uncertainty as a critical contingency, Sarasvathy (2001) suggests that entrepreneurs can thrive in uncertain environments by applying the principles of effectual reasoning.

Figure 1

Summary of Theories at Various Levels of Analysis



Source: Adapted from Lewin, Weigelt, and Emery (2003)

In sum, each of the five components is multidimensional, occurs at multiple levels, and is explained through level-specific theories. Moreover, these aspects of SE are highly intertwined with each other, such that one cannot be explained without the other, and their relations change over time. Based on the analysis of these five components, we conclude that SE is in danger of becoming a catch-all term that covers almost every aspect of strategic management and entrepreneurship—used to explain so much, it may ultimately explain very little. Deeply ingrained habits of thought that prioritize permanence, stability, organization, and control over transience, flux, transformation, and uncertainty serve to limit the potential of SE. This critique suggests that a new paradigm for SE must (1) consider the interactive effects of a multitude of interplays in the exploration–exploitation framework, (2) address critically differences between entrepreneurship, innovation, and newness rather than treat them synonymously or as a single construct, (3) disentangle the different loci of innovation, (4) develop a suitable architecture for an organizational form

that accommodates activities across different spatial dimensions, and (5) provide a sound ontological basis for theorizing change.

Scholarly work on these five components treated individually or collectively (as in SE) reflects one of two views: the social world as being made of things in which processes represent change in things, or one made of processes in which things are reifications of processes. Van de Ven and Poole (2005) note this to be a critical ontological distinction regarding the essential nature of organizations, one that challenges us to move past the traditional view of organization as a noun, and adopt an alternative view of organizing as a verb in a world of ongoing change and flux. The ontological significance of place, space, and time prompts a rethinking of the complex mediation, overdetermination, and instantiation of specific events, actions, and processes that have been approached in less spatialized and less temporalized ways in the conceptualization of SE. When dealing with complex phenomena, the notion of "laws" and the concept of "cause and effect" become problematic (Cilliers, 1998). The limitations described earlier suggest a need for a theoretical perspective that can accommodate the richly textured nuances of contemporary strategic challenges without succumbing to "mechanism independence" (Mackenzie, 2005).

An Alternative Theoretical Lens: Complexity Science

Complexity science offers a theoretical lens for exploring the complex interdependencies of a complex, pluralistic world "in which reversibility and determinism apply only to the limiting, simple cases, while irreversibility and randomness are the rules" (Prigogine & Stengers, 1984, p. 8). This requires a shift in worldviews from Newtonian mechanics to that of Einstein's relativity—from a gravitational force that depends only on a body's mass (*quantitative* with empirical evidence) to gravity as a quality of space-time that is affected by additional factors (*qualitative* with imagination of potentiality). We first examine the problem of different worldviews to uncover ontological, epistemological, and methodological considerations related to phenomena associated with SE. We then highlight differences between simplistic and complex systems by contrasting the Ireland et al. (2003) systems approach for SE with the complex adaptive systems (CAS) approach Brown and Eisenhardt (1998) use for entrepreneurial strategy. This explanation is followed by an exposition of the problem of self-organization and emergence, an issue that is intricately linked with both the problem of different world views and the problem of simplistic and complex systems.

The Problem of Different Worldviews

The reductionist nature of scientific methodology poses serious challenges for the dynamic and organic nature of entrepreneurship. Modernism centers on objective knowledge with a focus on deviations from and returns to a state of equilibrium, that is, linear causality and continuity with no gaps (Heylighen, Cilliers, & Gersick, 2007). On the other hand, postmodernists challenge this assumption of continuity and instead believe unpredictability and chaos are central to the world, not consequences of our lack of understanding or bounded rationality (Cilliers, 1998). Importantly, in this worldview there is no identifiable cause of change and knowledge is intrinsically subjective.

Our approach relies on a perspective *in between* postmodernism and modernism (Geyer, 2003)—a bridge *between* two opposing positions such as the physical sciences

Table 1

Summary of Fundamental Positions of Modern, Complexity, and Postmodern Science

	Modern (Positivist)	Complexity	Postmodern
Disciplines (typical)	Physical sciences (strictly scientific Newtonian framework)	Natural sciences (e.g., biology)	Social sciences (e.g., political science and sociology)
Paradigm	At or near equilibrium Deterministic (retrospective determinism) Tightly coupled (organization)	Far from equilibrium Quasi-stochastic (able to deal with surprise) Loose-tight coupling	Disequilibrium Stochastic Decoupled (disorganization)
Ontology	The world is given and presupposed. It is material, social (interpreted), and territorial	The world is fluid, processual, and aterritorial. It is neither presupposed nor given, but is constructed	The world is contingent, ungrounded, diverse, unstable, indeterminate, relational, and temporally specific
Epistemological position	Cartesian epistemology that reduce complex phenomena to analysis of their components; understood as simple, objective, absolute	Complexity-oriented epistemology understand phenomena as part of an entangled fabric of relations such that the whole is more than the sum of its interconnected parts	Different subject-positions inform different knowledge-claims; knowledge is perspectival and different perspectives are incommensurate
Theoretical basis	Order Rationality Predictability Reductionism Deterministic	Partial order (mediate order and disorder) Bounded rationality Predictability and uncertainty Reductionism and holism Probabilistic and emergent	Disorder (contested order) Relational rationality Unpredictable Irreducible Indeterminate
Methodological implications	Experimentation, quantification Obtain predictable, repeatable results Duplicate orderly natural science methods Universal and parsimonious social laws	Integration of experimentation and interpretation Principles and problematics	Relational interpretations Undermine truth claims Use deconstructivist techniques to disrupt modernist meta-narratives
Implications for novelty	No mechanism for endogenously creating novelty or growth in order and complexity	Emergent processes provide the system with novelty, and are responsible for growth in order and complexity	Multiple contested relational "orders" which rise and fall over time, but have no developmental path or direction

Sources: Beinhocker (2006); Dopfer et al. (2004); Geyer (2003)

and social sciences—to tackle the emergence of unpredictable properties that are "novel" in a self-organizing complex system. Cilliers (1998) supports the need for both mathematical equations and narrative descriptions, noting that one may be more appropriate than the other under certain circumstances, but both are equally scientific. These three worldviews are contrasted in Table 1, with a specific focus on ontology (what exists and how it exists), and epistemology (how we can come to know those things).

As indicated in Table 1, a complexity perspective offers a new set of lenses for seeing the world, and a new vocabulary with which to articulate a reality in which order is entangled with chaos. It entails a number of important shifts: from an analytical, linear perspective that decomposes the whole into its parts with cause–effect relations between the parts to a nonlinear (not a-linear) perspective in which the whole is more than the

sum of its parts; from static to dynamic; from evolution to emergence; from order to negotiated order; from certainty to uncertainty, and from at, or near equilibrium to far-from equilibrium.

The Problem of Simplistic and Complex Systems

In general systems theory (von Bertalanffy, 1968), a system is defined by a boundary between itself and its environment, dividing it from an infinitely complex exterior. The interior of the system is thus a zone of reduced complexity. Von Bertalanffy notes that, while systems theory is often identified with cybernetics and control theory, the latter is but a part of a general theory of systems. He warns against application of cybernetics to fields for which its concepts are not made. Feedback plays an important part in cybernetics—to better accomplish communication and control through information processing. It is also a key part of the behavior theory of the firm (Cyert & March, 1963; Simon, 1962). In the simplistic system represented by the Cyert and March model, behavior is driven by the quasiresolution of conflict, uncertainty avoidance, problemistic search, and organizational learning. Rules of thumb and standard operating procedures or "the memory of an organization" serve as stabilizing processes to reduce complexity, guide action, and control behavior. Organizational learning is fragmented, short term in focus, and incremental in nature. From a simplistic systems perspective, one cannot understand a real physical system at its critical point without forgetting the messy system details and focusing on the simplest mathematical game belonging to the same universality class (Buchanan, 2000). Here the aim is a grand theory with a universal theoretical framework that addresses all phenomena of interest.

Whereas general systems theorists search for homologies and focus on similarity, complex systems theorists focus on difference—a distinction that incidentally also differentiates modernists and postmodernists. De Landa (2006) explains that reductionists tend to focus on the parts and their interactions, but it is the "interactions" (among parts and between parts and their environments) that constitute the system. Noting that the "whole" does not simply float on top of it all, he argues that reductionism is "systems science" in disguise, and that interactions are far more important than the nature of the parts. Hence the messy details—the presence of multiple causal loops that interact with each other—are the principal difference that distinguishes a complex system from a simplistic system. Table 2 summarizes the differences between systems that are complex, and others that are intrinsically simplistic because they are theoretically reducible, with entrepreneurial strategy (Brown & Eisenhardt, 1998) and SE (Ireland et al., 2003) as representative examples of the differences. In both instances the firm is the unit of analysis and the focus is on economic (profit) opportunity, routines (simple rules), and incremental, firm-level, continuous innovation in pursuit of competitive advantage.

The SE model (Ireland et al., 2003) uses a general systems theoretic framework (with characteristics of cybernetic control) to which some "nonlinearity" and "heterogeneity" in a nested hierarchy has been added. Network theory and the resource-based view are combined with behavioral assumptions to account for entrepreneurial action. However, entrepreneurial action is not considered to be a fundamental source of change beyond the opportunity-seeking behavior associated with continuous streams of innovation. Systems that make use of a Newtonian model of dynamics are not able to account for the fact that a system can change identity, increase information content, and use such content to change its constitution by introducing elements in irreducible and

Table 2

A Comparison of the Theoretical Foundations of Strategic Entrepreneurship and Entrepreneurial Strategy

	Strategic entrepreneurship (e.g., Ireland et al., 2003)	Entrepreneurial strategy (e.g., Brown & Eisenhardt, 1998)
Main focus	Behavioral	Evolutionary
System type	General Systems Theory Cybernetics	Complex Adaptive Systems
Theoretical foundations	[The Carnegie School] March, 1991; Simon, 1962	[Santa Fe Institute] Kauffman, 1993 Waldrop, 1992
Micro–macro relationship	Social system *and* economic system Firm responds to the environment, i.e., micro–macro interaction	Social system *within* economic system Firm is embedded in and changes its environment
System characteristics	Simple, linear, and equilibrium seeking Whole is sum of parts	Open, dynamic, nonlinear Whole is more than sum of parts
Origins	Physics (stability, equilibrium)	Biology (structure pattern, self-organization)
The nature of evolution	Adaptation and evolution of the firm	Dynamic co-evolution of both the firm and the environment
Focus	Organizational learning Balance (exploration–exploitation)	Development of new rules and routines Variation-retention-selection
Nature of opportunity	Pre-existing profit-making opportunity to seek out and exploit	New opportunities arise from technological innovations
Role of technology	Technology as a given or selected on economic criteria	Technology in flux, endogenous to the system
Type of nonlinearity	Nonlinearity ascribed to negative and positive feedback loops Mostly "same cause, same effect"	Nonlinear interactivity, i.e., "small cause, large effect" or "large cause, small effect"
Type of self-organization	Primarily self-regulatory processes	Creative, self-generated, adaptability-seeking behavior conferred by emergent phenomena
Type of equilibrium	System tends toward a final state of equilibrium or homeostasis e.g., "equifinality" in GST	System is "beyond equilibrium" (i.e., multi- or nonequilibrium)
Type of attractors	Only one "attractor," i.e., a final state of equilibrium	Different kinds of attractors (e.g., fixed point, limit cycle, strange)

Sources: Beinhocker (2006); Dopfer et al. (2004); Goldstein (1999); Kauffman (1993)

unpredictable ways (Cilliers, 1998). In contrast to simplistic systems, complex systems consist of many nonlinearly interacting nondecomposable elements. The interactivity is such that the system is not reducible to multiple systems, and contains a sufficiently complex interactive mix of causal loops to allow the system to display behaviors that characterize the system (De Landa, 2006). A complex system cannot simply be reduced to two weakly interacting systems (as in the SE model) because there is a nontrivial relationship between its components and the system's macroscopic properties. Potts (2000) sums it up well:

> [T]he hypothesis of evolution towards complexity is a conjecture to the effect that a balance between order and chaos, between stasis and change, is the ultimate principle underlying all evolutionary processes. Where *equilibrium* is the expression of 'balance' in an *inert, mechanical world* of point-like existence, *complexity* is the expression, the structural signature, of balance in a world of *interacting dynamic*

systems. The hypothesis of *evolution towards complexity* is the logical principle that interlinks the geometry of all economic systems (p. 91; emphasis added).[1]

Systems that are both complex and adaptive (capacity to change and learn from experience) are called CAS. The CAS exhibits recursive macro–micro feedback loops with coevolutionary dynamics at the "edge of order and chaos" (Waldrop, 1992), where there is "order for free" or "order from chaos." CAS models merge complex systems theory with the behavioral theory of the firm and Darwinian principles of evolution (especially variety, selection, novelty, and inheritance) to explain a wide range of phenomena: The firm as a CAS examines strategic dynamics at the firm level (Brown & Eisenhardt, 1997; Burgelman & Grove, 2007); the market as a CAS focuses on competitive dynamics and macro-level economics, whereas the economy is treated as a CAS in evolutionary economics to model dynamic competition and technological innovation (Dopfer et al., 2004).

The Problem of Self-Organization and Emergence

Emergence has resurfaced as an important topic for investigation for organizational theorists and entrepreneurship scholars (McKelvey, 2004). Different worldviews cause much ambiguity in the use and interpretation of the term emergence. Emergence is not growth, nor appearance of resultant properties. As Lewes (1874, p. 79; emphasis added) explains:

> Every resultant is either a sum or a difference of the co-operant forces; their sum, when their directions are the same—their difference, when their directions are contrary. Further, every resultant is clearly traceable in its components, because these are homogeneous and commensurable. . . . It is otherwise with emergents, when, instead of adding measurable motion to measurable motion, or things of one kind to other individuals of their kind, there is a *cooperation* of things of *unlike kinds*. . . . The emergent is unlike its components in so far as these are *incommensurable*, and it *cannot be reduced to their sum or their difference*.

In other words, emergence is not the *result* of the process of interactions. Rather, it takes place *during* the process of interacting. Reductionist theorists can explain interactions of the parts (individual agents), but not the whole, which limits them to epistemological emergence (Waldrop, 1992). On the other hand, systems theorists' holistic paradigm downplays the role of intentional action by individual agents (parts) and can only explain activity at the global level using level-specific laws (von Bertalanffy, 1968). Emergentists reject both reductionism and holism, because these ontologies cannot account for the emergence of novelty (Cilliers, 1998), which is "above all a product of coupled, context dependent interactions" (Holland, 1998, p. 122) that may be multiplicative, not merely additive (De Landa, 2000).

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1. It is important to note that Potts (2000) is referring to "evolution of complexity," not Darwinian evolution or growth. Emergent order-creating processes center on a hierarchical model of the world with a "from-to" structure associated with evolutionary economics. Emergence here is used as a synonym for growth; i.e., each new entity has unique features that differ from its predecessor. This is typically modeled as coevolutionary processes with recursive relationships among variables within the system. In this change-related perspective on emergence, there is no causal decoupling, which is an important criterion for diachronic emergence. The latter displays ongoing emergent processes in which there is no end state; the processes of change create new dynamics—a new form of continuity (Bonta & Protevi, 2004).

Silberstein and McGeever (1999, p. 185) raise concerns that, by equivocating on the term emergence, researchers may actually be asserting different things, such that it becomes unclear whether a specific claim is merely an epistemological one regarding the ineliminable nature of some "higher-level" explanation, or it is a robust ontological claim about the emergence of some novel feature of reality. In epistemological emergence, emergence is but an artifact of a particular model (formalism generated by macroscopic analysis, functional description, or some other kind of "higher-level" description), whereas ontological emergence (features of systems or wholes that possess causal capacities not reducible to any of the intrinsic causal capacities of the parts or to any of the [reducible] relations between the parts) has been argued to be the important kind of emergence—an underrepresented issue in the SE literature.

Whereas modernism commits itself only to an epistemological stance toward models, complexity science addresses the question of the emergence of relatively simple functional structures from complex interchanges of the component parts of a system (Bonta & Protevi, 2004). This is a central and irreducible ontological commitment. Methodological individualists question the use of social structure to explain human behavior in that they deny emergence above the level of the subject. Social phenomena are seen as aggregates of individual acts. To account for the truly novel and to find ways that maintain conditions for future creativity, Bonta and Protevi call for a focus on diachronic (dynamic) emergence in which emergent entities develop temporally from antecedent entities. Goldstein (1999, p. 65) explains,

> those who cannot accept the possibility of more than one ontological level also cannot accept the possibility of the radical novelty that accompanies the new level coming into being with emergence. They have a bias against real novelty. With nonlinear dynamics and complexity theory, hard-core reductionism of the ontological-level monist variety has finally come upon natural processes that will not yield to the reductionist onslaught. Whereas traditional physics has had tools for detecting either complete order or complete randomness, the middle ground of order has been left out. But it is precisely this middle ground that is the locus of emergence.

Thus, there are at least three problems that need resolution in order to move beyond theorization around evolution, adaptation, and growth toward emergence, qualitative novelty, and development—"entrepreneurship, after all, is a science of turbulence and change, not continuity" (Bygrave, 1989, p. 28).

SE Through the Looking Glass of Complexity Science

So what new insights about SE can one expect to gain from a complexity science perspective? In this section we explore this question by introducing a conceptual resource, called an opportunity space, to theorize the genesis of entrepreneurial opportunities as a collective enterprise. Our approach seeks to endogenize the source of entrepreneurial opportunities. Thus we move our level of description to the opportunity space to distinguish the focus of SE from that of entrepreneurship (the individual) and strategic management (the firm) for the purpose of investigating the loci of innovation associated with entrepreneurial opportunities. Selected characteristics of the opportunity space are examined with an emphasis on the role played by (1) nonlinear dynamics and dissipative structures; (2) flows and fluctuations far from equilibrium; and (3) feedback loops.

An Opportunity Space: Relational Openness and Contextual Surplus in a Boundaryless System

Complex problems such as innovation involve multiple causal interactions between several systems with fuzzy system–environment boundaries (Chen & Van de Ven, 1996). Multiple linkages with numerous feedbacks across scales in time and space, and throughout the entire system of firms, society, and the economy, make it impossible to address the challenges of innovation other than as a system with three interdependent, integrated dimensions—organizational, economic, and sociocultural. As a result of globalization, processes have become so interwoven that many actions, although local in origin, are regional, national, or global in their effects (Armitage, Berkes, & Doubleday, 2007). Thus the opportunity space is conceptualized as an open, nonlinear, dynamical, dissipative, self-organizing system (a subsystem of the global economy) that is open and far from equilibrium.

By opportunity space we mean a form of organization in which components participate in an assemblage (De Landa, 2006), that is, "a multiplicity which is made up of heterogeneous terms and which establishes liaisons, relations between them, across ages, sexes and reigns—different natures. Thus the assemblage's only unity is that of co-functioning; it is a symbiosis" (Deleuze & Parnet, 2002, p. 69). This implies that "a relation may change without the terms changing" (p. 55). In an assemblage,[2] the whole is characterized by "*relations of exteriority*" (De Landa, p. 10; emphasis in original); that is,

> while its *properties* are given and may be denumerable as a closed list, its *capacities* are not given—they may go unexercised if no entity suitable for interaction is around—and form a potentially open list. . . . And given that an unexercised capacity does not affect what a component is, a part may be detached from the whole [and plugged into a different assemblage in which its interactions are different] while preserving its identity.

According to Bourdieu (1998, p. 6; emphasis in original), "[t]he idea of difference, or gap, is at the basis of the very notion of *space*, that is, a set of distinct and co-existing positions which are exterior to one another and which are defined in relation to one another through their *mutual exteriority* and their relations of proximity, vicinity, or distance, as well as through relations of order, such as above, below or *between*." In other words, heterogeneous components (e.g., individuals and social artifacts such as technology, markets, or firms) with symbiotic relationships are "locked into" relational fields of varying geographical reach around narrower spheres of activity, or more precisely, the entire

2. De Landa (2006, pp. 3–9) distinguishes assemblage theory from Hegelian dialectics and structuration theory, wherein "wholes possess an inextricable unity in which there is a strict reciprocal determination between parts" as a result of "*relations of interiority*." Created by philosopher Gilles Deleuze, assemblage theory: (1) entails a realist social ontology (social entities exists independent of our perceptions of them); (2) centers on "the processes that create and stabilize their historical identity"; (3) resolves issues regarding the micro–macro link; (4) overcomes problems of reductionism associated with methodological individualism, social constructivism, the meso-level or nested hierarchies; (5) distinguishes between material and expressive resources in an ontologically consistent manner; (6) avoids any reference to essences; and (7) gets rid of teleological, or deterministic sources and stage-like accounts of processes. These characteristics are crucial for emergence to take place. For example, a city is an assemblage of people, networks, organizations, and infrastructure such as buildings and streets, together with flows of materials and energy. Thus larger assemblages (city) emerge from recurring patterns of interaction between smaller assemblages (people, organizations)—resulting in a flat ontology constituted by "individuals" occupying different spatiotemporal scales. Following Kauffman (1993), we use the term "meshwork" to refer to an interlocking system of complementary functions.

nonunified (remain disparate without being fused into some sort of unity) system is a multilayered, complex interaction of emergent systems (De Landa, 2006). Operational closure depends on context and observer.

As an open, nonlinear dynamical complex system with multiple equilibriums the opportunity space[3] acts as the "energetic flesh that is the seat of the processes of self-organization" (De Landa, 2000, p. 304). The system is sustained by irreversible inflows of materials, energy (low entropic), and information from its the surroundings, energy dissipation through transformation processes as it flows through the system, with outflows of materials, energy (high entropy), and information back to the environment—resulting in local self-organization processes and global entropy production (Prigogine & Stengers, 1984). Capra (2005, p. 37) notes, "Prigogine called the open systems described by his theory 'dissipative structures' to emphasize this close interplay between *structure* on the one hand and *flow* and *change* (or dissipation) on the other hand." Thus the flows are "neither de-synchronized fragmentation or a continuation of Euro-American time senses of possibilization, but reversible switches between them . . . it is the *flow of energy* through a system that creates the stable states in the first place." He adds, "The theory of dissipative structures explains not only the spontaneous emergence of order, but also helps us to define complexity. Whereas traditionally the study of complexity has been a study of complex structures, the focus is now *shifting* from the *structures* to the *processes* of their emergence" (emphasis added). Importantly, one "process is always linked to another, and a process is *activated by an event*" such that an *event* marks "the *transition* from one process to another" (Mackenzie, 1986, p. 46). These three characteristics—*forms* (pattern, structure), *functions* (tendencies, transitions), and *flows* (and fluxes)—are the foundation of the nonhierarchical architecture of the opportunity space, which we discuss next.

The Role of Nonlinear Dynamics and Dissipative Structures

In dissipative systems far from equilibrium, patterns emerge in the multidimensional "phase space," which is the locus of interactions of dynamic forces (Prigogine & Stengers, 1984). It represents the range of behaviors open to the system. Here one has a qualitative understanding of the emergent properties of the system, and the macrobehavior of the system, but no quantitative knowledge of the microbehavior of the system. The phase space has various features, which include: (1) *attractors*—a region of phase space toward which systems tend once their states approach a certain condition in the basin of attraction (attractors represent patterns of behavior of the real system); (2) *bifurcators*—the threshold at which the system flips between one region of phase space and another (it represents trigger points when the real system changes patterns qualitatively); and (3) *the zone of sensitivity*—the region where bifurcators cluster and amplify each other's effects so that

3. The term "opportunity space" has been used before in the context of a "business opportunity space" (Eliasson, 1991), which represents the unknown knowledge of different actors in the state space as well as the potential (but unknown) combinations of this knowledge. A search into the same state space (i.e., problem space) for more investment opportunities will create new opportunities (new combinations with so far undiscovered combinations) (Eliasson). However, the term "opportunity space" in this context refers to a mental construct that encompasses all potential venture ideas (i.e., a fixed place). The related but different notion of a "problem space" (Newell & Simon, 1972) consists of a set of initial states (means), a set of goal states (ends) and a set of path constraints—this is reflected in Sarasvathy's (2001) theory of effectuation where boundedly rational actors use knowledge judgments to make decisions as they *search* for new means–ends relationships in this "problem space."

small differences in system parameters can provoke drastic changes in behavior (Bonta & Protevi, 2004). The global condition (actual behavior) of the system is represented by a point in the phase space—this point traces a trajectory over time.

A dissipative system far from equilibrium exists in a thermodynamic gradient and this intensive difference[4] "drives extensive fluxes of energy" (Mackenzie, 2005, p. 46). Intensive differences "have a morphogenetic effect . . . and when not allowed to get cancelled (as in nonequilibrium physics) display the full potential of matter-energy for self-organization" (De Landa, 2006, p. 204). Actors self-organize; that is, "a self-ordering set of productive connections between forces without reference to an external governing source of order" (Bonta & Protevi, 2004, p. 9) leads to "the arising of novel and coherent structures, patterns, and properties" (Goldstein, 1999, p. 49). Each attractor is capable of many different individuations (instantiations). At higher (global) levels, attractors are "morphogenetic fields," that is, "dynamic mixtures of energy, matter" and "catalytic replicators of different kinds (genes, memes, norms, routines)" (De Landa, 2000, p. 212). Herein lies the genesis of potential opportunities, which "are intrinsic features of matter-energy flows subject to non-linear dynamics and nonlinear combinatorics" (p. 309) that keep "dynamics away from global attractors" (p. 286) and the system far from equilibrium. Massumi (2002, p. 226) explains that "a potential does not preexist its emergence. If it doesn't emerge, it's because it wasn't really there. If it does, it really only just arrived. Potential is an advent. It is the contingency of an event in the future imperfect: 'will have' (precessive processing)." Thus, potential opportunities "do not exist in some transcendental heaven waiting to be incarnated" (De Landa, p. 309).

When the system reaches a critical threshold of complexity due to "intensifications in the flow of energy" (De Landa, 2000, p. 279), it undergoes a bifurcation (phase transition to a new state) where complexification accelerates. Prigogine and Stengers (1984, p. 190; emphasis added) explain that

> Even in those [bifurcation regions in which an individual, an idea, or a new behavior can upset the global state], amplification obviously does not occur with just any individual, idea or behavior, but *only with those that are* "*dangerous*"—that is, those that can exploit to their advantage the nonlinear relations guaranteeing the stability of the preceding regime. Thus . . . the same nonlinearity may produce an order out of the chaos of elementary processes and still, *under different circumstance*, be responsible for the destruction of this same order, *eventually* producing a new coherence beyond another bifurcation.

Theorizing about novelty requires "nonlinear combinatorics" that can account for novelty "in terms of building blocks, and the combinatorial productivity of different blocks," that is "a succession of assemblages that interact with each other, passing through several states [creating conditions that stabilize the next one] until they reach a climax" (De Landa, 2000, p. 105). In this approach "reality is a single matter-energy undergoing phase transitions of various kinds, with each new layer of accumulated 'stuff' simply enriching the reservoir of nonlinear dynamics and nonlinear combinatorics available for the generation of novel structures and processes" (p. 21). Although several "types of self-organization give rise to emergent or synergistic properties, they cannot deal with *novel emergent properties*"

4. The entities in the assemblage are described in terms of *extensive properties* (length, area, amount of energy, number of components), *intensive properties* (density of network connections, degree of centralization, rate of growth) and *capacities*; that is, "what they are capable of doing when they interact with other social entities" (De Landa, 2006, pp. 6–7).

(p. 277; emphasis in original), and only some novel combinations will occasionally "possess emergent properties. In turn these synergistic combinations . . . become the raw material for further mixtures" (p. 26).

Synopsis 1: Self-organization and emergent properties

Entrepreneurial activity intensifies flows (of resources, energy, information) at the system level, driving the system further away from equilibrium, leading to more energy dissipation and higher entropy outflows to the environment. This is not a linear relationship. The further the system is from equilibrium (due to dissipation of available energy), the greater its complexity, and, the more numerous the possible forms (meta-stable structures) become. A qualitative change (bifurcation) renews the system's capacity for entropy generation, that is, increases the morphogenetic potential of the opportunity space.

The Role of Flows and Fluctuations Far From Equilibrium

Attractors (dynamically stable states) represent patterns of stability and patterns of becoming resulting in a fluctuating identity that is dynamically constituted from coexisting and interacting flows (Bonta & Protevi, 2004). Catalytic replicators become more dependent on energy flows far from equilibrium (De Landa, 2000). On the one hand, a catalyst is capable of "constraining matter-energy flows of different kinds, by switching between two dynamically stable states (attractors) which in turn react back on these flows and processes to constrain them in a variety of ways (stimulating them or inhibiting them)" (p. 292), thereby accelerating the process. On the other hand, "catalytic constraints may combine with one another" to unleash a chain reaction of dynamic changes (symmetry-breaking events).

Fluctuations—adaptive tensions between the edges of order and chaos (McKelvey, 2004)—act as accelerators that "trigger intensifications or diminutions in the flows of matter-energy" (De Landa, 2000, p. 292). A mixture of hierarchies (strata of homogenized coagulations) and meshworks (self-consistent aggregates with heterogeneous components) emerges from these flows. The changing proportions of hierarchies and meshworks in this mixture depend on coexisting movements of *destratification* (generating meshworks) and *restratification* (generating hierarchical structures). The nonlinear and relatively destratified flows of energy, material, and information—each with their own forms and functions—constitute the flowing reality of an opportunity space "animated from within by self-organizing processes" (De Landa, p. 260). But this is only part of the picture. Once in place, the meshworks and hierarchies react "back on the flows, either to inhibit them or to further stimulate them." In other words, inherent morphogenetic (structure-generating) potential of the flows in the opportunity space gives rise to "structures [that] operate at a certain degree of stratification" (p. 262), which in turn perform "destratifications and restratifications on the flows that traversed them" (p. 263). Moreover,

> the hierarchy-generating machine involves a process of double articulation: a sorting operation that yields a homogeneous distribution of elements and a consolidation operation that defines more or less permanent structural linkages between sorted materials. The meshwork-generating machine, on the other hand, articulates divergent but partially overlapping components by their functional complementarities, using a variety of local intercalary elements as well as endogenously generated stable states.

Table 3

Key Characteristics of the Infrastructure in the Opportunity Space

	Opportunity space A substratum for the genesis of entrepreneurial opportunities		
Opportunity type	Economic opportunities		Entrepreneurial opportunities
Structure type	Hierarchies *(centralized body of rules)*	⟺ *Hierarchies & meshworks co-exist & constantly interact with each other*	Meshworks *(decentralized system of constraints)*
Attractor type	Space of possibilities *(actualized attractors)*		Domain of potentials *(unactualized attractors)*
Cycle type	Transformative cycles of economic opportunities		Transformative cycles of entrepreneurial opportunities
Cycle characteristics	Stabilizing cycle *(maintains order, control, structure)*		Destabilizing cycle *(increases diversity, heterogeneity)*
Emergence type	Synchronic emergence—order creating	⟺ *Complexification and intensification of flows maintain the mixture*	Diachronic emergence—novelty creating
Innovation type	New or recombinations *(new, incremental, continuous)*		Paradigm change (frame-breaking) *(novel, radical, breakthrough)*
Outcome from innovation	Schumpeterian growth	⟺	Schumpeterian development
Emergent behavior	Coadaptation evolution (path dependent)		Reconfiguration (disruption) Revolution (path creation)
Response type	Continuity *(maintains past traditions)*	*Enter into systematic relations*	Discontinuity *(cutting edges of creation)*
Primary processes	Routines, rules, and norms Reinforcement learning (optimizing)		Experimentation iterative learning (antioptimizing)
Longer term impact	Renewal (mutation) Survival and adaptation (variation-selection-retention)		Socioeconomic change Transformation on multiple levels (e.g., industry, market, society)
Tendency	Tendency is toward equilibrium *(respond to change)*		Tendency is away from equilibrium *(create change)*

Sources: Bonta and Protevi (2004) and De Landa (2000, 2006)

This gives rise to an apparent paradox: "[T]he creation of novel hierarchical structures through restratification is performed by the most destratified element of the previous phase" (p. 266), thereby "freeing them from many constraints and literally setting them into motion to conquer every available niche" (p. 27). This mobilization of complexity occurs as a "proliferation of practices" (Stengers, 1997). Key differences between economic and entrepreneurial opportunities are summarized in Table 3.

Synopsis 2: Morphogenesis (form-generating processes) in the opportunity space

The combined effects of numerous flows in the morphogenetic field give rise to form-generating processes (hierarchy generating or meshwork generating). The opportunity potential of the morphogenetic field gives rise to entrepreneurial opportunities (the domain of potentials) which are in turn individuated as various economic opportunities (space of possibilities).

The Role of Feedback Loops

Complex feedback loops, both negative (deviation counteracting) and positive (deviation amplifying), play an important role (De Landa, 2000). On the one hand, negative feedback loops create stereotypical behaviors if the system is not pushed beyond the threshold (Bonta & Protevi, 2004). In this instance, order is sustained and the system is kept in a fixed repertoire (represents normal system behavior in its patterns). In synchronic emergence, emergent properties at the global level are built on arrangements of components at the local level (i.e., macro and micro levels are present at the same time). Here the system moves toward increased order to ensure its survival.

On the other hand, positive feedback loops can push the system past its threshold, leading to three possible outcomes: (1) If pushed too far beyond normal fluctuations, chaos ensues (no patterns are present and the system dies); (2) the system moves to a new pattern in the fixed repertoire—this is developmental learning (i.e., the system moves to a new pattern); or (3) stereotypical behavior patterns are overwhelmed to create new patterns and thresholds of behavior in the system (i.e., radical change occurs when bifurcation flips the system to a whole new state, that is, a change in behavior with emergence of novelty). The latter is "diachronic emergence." Our interest is the emergent unity from collaboration between diachronic emergence (emergence of novelty) and synchronic emergence (emergence of order).

Both change and organization are aspects of change (Tsoukas & Chia, 2002)—they are coemergent phenomena because "change implicates its other . . . organization" (Chia, 1999, p. 224). This "interplay of stability and dynamism [provides] a self-reinforcing virtual spiral across time" (Ropo & Hunt, 1995), which implies that self-organization processes simultaneously act as the driving force (symmetry-breaking practices resulting in novelty) and the glue (order-creating practices resulting in new symmetries) (De Landa, 2000). Emergence of a new arrangement (a new functional structure or new forms of processes) is similar to a change of state (e.g., a phase transition in water).[5] Once formed, new arrangements undergo recombinations with variation, opening up the possibility for further exploration in "a space of possible forms" (p. 264) as a result of

> the interaction between two different processes, innovation and routinization—that is, between the spontaneous proliferation of flexible skills and procedures and their gradual conversion into rigid, uniform routines . . . the process of innovation pushes economic evolution far from equilibrium, toward the multiple forms of stability that characterize self-organization, while the process of routinization [to control] brings the economy back to equilibrium (p. 297).

The types of bifurcations associated with qualitative change (novelty) include business models (Zott & Amit, 2007), a rule change in the industry (Dopfer et al., 2004) or a paradigm change at the societal level (Kuhn, 1970). Paradigm-shifting dynamics create "opportunity driven cycles in entrepreneurial activity that in turn cause waves of innovation and cycles in economic growth" (Sanders, 2007, p. 339), acting as a catalyst

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5. Protevi (2007) uses water as an example to explain the differences between quantitative entities (forms), intensive processes (flows), and qualitative events (force—transition). The three *forms* of water—solid, liquid, and gas—can be *quantitatively assessed*, such as the thickness in feet of the Greenland ice shelf or the percentage of humidity. *Intensive processes* of water are the manifold ocean currents (e.g., when the Gulf Stream brings equatorial heat north towards Greenland, the temperature gradually drops, while density and salination increase steadily as the stream joins ocean currents). *Linked rates of change* in the hydrological cycle's difference-driven processes lead to phase transitions, for example, the change from a liquid to a gas (evaporation)—an event that is associated with a qualitative change in state (a transformation).

for change and "engines" of innovation (or development motors) (Van de Ven & Poole, 1995).

Synopsis 3: A range of newness from new to novel

Synchronic emergence keeps the system stable (increases order, coherence, identity) by transforming economic opportunities[6] *into new products, markets, or ventures without changing patterns of behavior. Diachronic emergence moves the system away from order and leads to emergence of entrepreneurial opportunities (e.g., novel business models) that change behaviors and result in an ecosystem of new potentials. Thus, new opportunity structures with varying degrees of newness emerge from the self-organized activity in the opportunity space.*

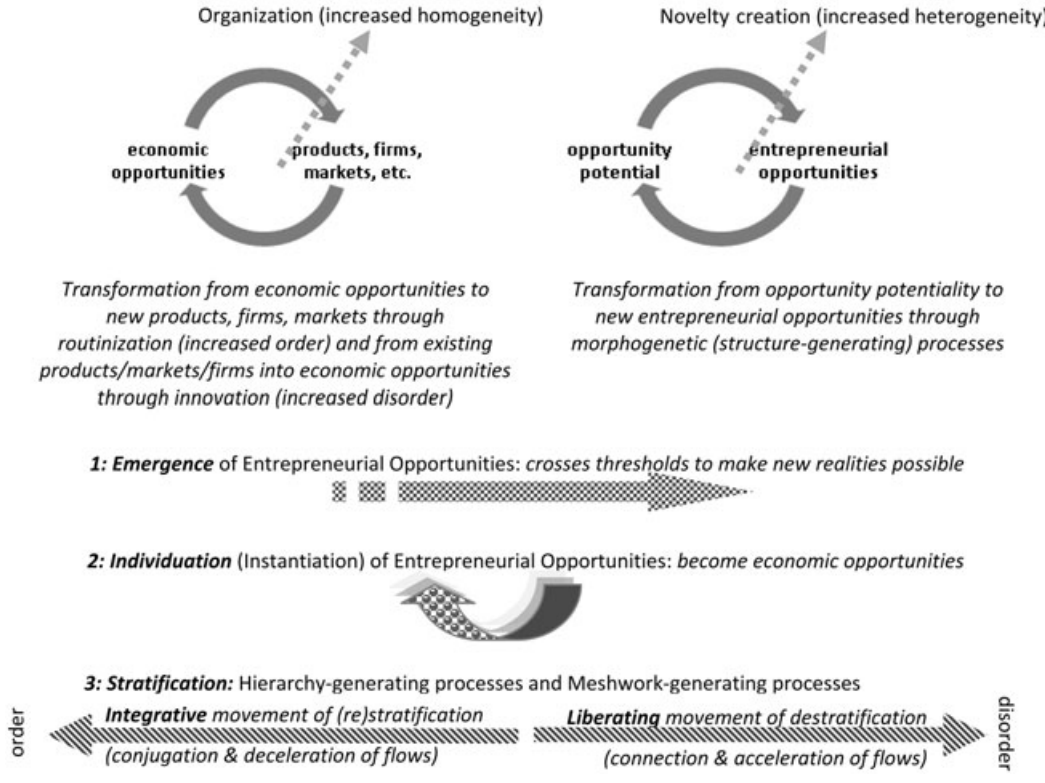
The opportunity space's morphogenetic (structure-generating) potential arises from a conjunction of loops of triggers, flows of different kinds, and the accelerators that mobilize them—acting as a "convective cell" (De Landa, 2000, p. 257). It is the *degree of intensity* of key parameters—strength of the flows and degree of connectivity in a meshwork; strength/thoroughness of the sorting process and degree of consolidation in the double articulation; rates of mutation/recombination and degree of coupling between coevolving species; degrees of destratification—which "defines the dynamical state of the structure-generating processes" (p. 264). Autocatalytic dynamics "cannot emerge when hierarchical components overwhelm meshwork components" (p. 34). Therefore it becomes critical to ensure optimal intensity of flows that will foster the right proportion of homogeneity and heterogeneity. Synergistic effects from the dynamic interplay of catalytic loops may be further enhanced by symbiotic and amplifying effects. For example, autocatalytic dynamics in the entrepreneurial opportunities that underpin Apple's iPod, Nintendo's Wii, and Linux were intensified even further by social amplification of the flows of energy, resources, and information creating reinforcement mechanisms that allowed the rapid spread of information through social networks, leading to new potentials and creative possibilities. The key processes (transformation, emergence, individuation, and stratification) are summarized in Figure 2.

In sum, the interrelated and interweaving heterogeneous processes in the opportunity space—ongoing multiscalar, multicentric, multipolar, multitemporal, multiform, and polyrhythmic dynamics—influence, and are influenced by, one another in complex and non linear ways. These dynamics are both orderly and disorderly, and they are not hierarchically organized. Emergent entrepreneurial opportunities expand and contract as a result of fluctuations in the indeterminate zone (the zone of sensitivity) and the origins of new paths can be found in the simultaneous presence of surprise and predictability, novelty and reproducibility, chance and necessity. Thus entrepreneurial opportunities (the meshwork-of-an-opportunity) are inherently emergent, dynamic, and organic, and they are individuated (instantiated) as discrete economic (profit-making) opportunities through various simultaneous and symbiotic structure-generating processes (of the entrepreneurial or strategic kind), which are in turn transformed into innovations of different kinds (e.g.,

6. There is significant disagreement about the nature and source of entrepreneurial opportunities. We treat entrepreneurial opportunities as distinct from profit-making opportunities (Ardichvili, Cardozo, & Sourav, 2003), economic opportunities such "as a situation in which a person can create a new means-ends framework for recombining resources that the entrepreneur believes will yield a profit" (Shane, 2003, p. 18); the cognitive process of opportunity discovery (Casson, 1982, p. 45); market opportunities associated with asymmetric information (Kirzner, 1973) or supply and demand (Sarasvathy, 2001); and exogenous technological opportunities (Schumpeter, 1934). In this article, the various references to types of opportunities are treated as "economic opportunities" that differ from "entrepreneurial opportunities."

Figure 2

Schematic Diagram of Generative Processes in the Opportunity Space



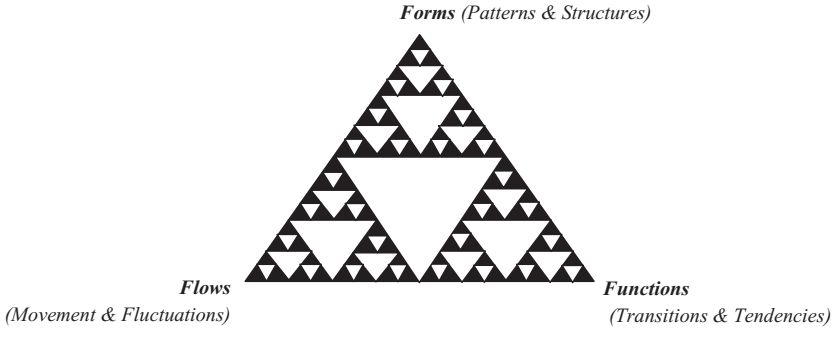
new products, markets, or firms). Following De Landa (2000, p. 13), we suggest that products, markets, and firms are "historical constructions, slow accumulations of adaptive traits cemented together via reproductive isolation." Successive innovations lead to additional diverse economic opportunities (Shane, 2003). Ongoing relays between the various loops act as the engines that keep the economy's circular flow of customary, habitual behavior near equilibrium in motion (i.e., through economic opportunities) (Schumpeter, 1934), but also infuses entrepreneurially driven change to keep the system out of equilibrium and in flux (by generating entrepreneurial opportunities). Thus, far from being preexisting entities waiting to be discovered or cognized, the fluid metastable newcomers (entrepreneurial opportunities) make new forms (Schumpeter) or (re)combinations possible. In other words, entrepreneurial opportunities emerge from systemic entrepreneurship-induced change (endogenously) and act as the source of autocatalytic cycles of entrepreneurial activity.

A Rearticulation of SE: Putting the Pieces Together in a Different Way

The factors that come into play in explaining generation of novelty within organizations are highly context dependent, as no ideal solution exists (one size does not fit all).

Figure 3

A Visual Representation of the Degree of Hybridity in the 3F Paradigm for SE



Instead of developing universal laws or axioms as a generic response, we need a set of principles specific to the local context (idiosyncratic solutions). This plurality highlights the need for an SE paradigm that can address circular causality (an effect becomes a cause), multicausality, nonlinear linkages, feedback loops, metastable discontinuities, time-dependent processes, and self-reinforcing mechanisms; that is, a way of approaching SE that is "as complex as the phenomenon itself" (Ropo & Hunt, 1995, p. 108).

An Alternative Paradigm for SE

Complexity science in general and the notion of an opportunity space in particular facilitate a new articulation of, and enable an alternative paradigm for, SE, which we shall call the 3F (*form-flow-function*) paradigm. The opportunity space is "neither integrated nor completely differentiated, but it performs on the edges of fractional differentiations and local integrations" (Etzkowitz & Leydesdorff, 2000, p. 119). Moreover, phenomena of interest in SE seem to exhibit a fractal "architecture"; that is, they exhibit characteristics of complex systems with high degrees of hybridity between the constitutive elements and therefore cannot be sufficiently addressed at a particular level of analysis. Mandelbrot (1982) coined the term "fractal" to capture "a rough or fragmented geometric shape that can be split into parts, each of which is (at least approximately) a reduced-size copy of the whole." Thus fractal geometry[7] describes images and objects with irregular, endlessly repeating, self-similar shapes at ever-finer levels of analysis (i.e., fractal dimensions between 1 and 2). The scale-free fractal "architecture" shown in Figure 3 is inspired by the cradle-to-cradle fractal triad of McDonough and Braungart (2002) used in the design of eco-effective products. This conceptual-philosophical triangle illustrates how the same

7. It is worth noting the distinction between two commonly confused theories: complexity and chaos theory (see Mackenzie, 2005). We are not arguing in favor of chaos theory (simple rules can generate very complicated dynamics), which is essentially still positivist (Bygrave, 1989). Rather, the fractal triad offers visual insight into the challenge nonlinear dynamics present to strictly linear, logical, or hierarchical thinking. Two properties of fractals are relevant for our discussion: (1) self-similarity and scale invariance (infinite nesting of self-similar structure—the same features appear at all levels of analysis); and (2) formation by iteration (form is repeated over a variety of scales). The opportunity space can be treated as a fractal of the economy; thus, if one understands the flows, forms, and forces in the opportunity space, one simultaneously has a view of the whole economy.

systemic principles apply to all emergent levels, temporal dimensions, and across spatial scales.

An alternative direction for SE is charted around a paradigm that privileges emergent *forms* (patterns and structures), synergistic *flows* (fluxes and movement), and creative *functions* (tendencies and transitions) within an evolving opportunity space, supplemented by structure-generating processes and complexified by *contradiction* (paradox and ambiguity play a role), *choice* (between determinism and chance), and *context* (time and space matter). Put together, these principles offer a fresh perspective on SE phenomena. The 3F paradigm addresses the *what* (fluctuations and transformations), *why* (complexity), *how* (self-organization and emergence), *who* (different perspectives, e.g., entrepreneur, firms, institutions, or peripheral), and *where* (the opportunity space) of stability and change. Importantly, time (*when*) acts as a unique source of heterogeneity because of its irreversibility. As a conceptual tool that is integrative and evolutionary, the fractal triangle reveals the subtle relations between pattern creation and pattern identification, and shows how, at any level, each action impacts the whole system. Individuals change from being resource allocators (control and order) to active participants in an opportunity space (a negotiated order between absolute order and disorder).

What Is the Domain of SE?

In the 3F paradigm, SE is the domain for scholarly research on fractal phenomena (systems within systems) such as innovation processes that are (1) intertwined with, and occur in tandem with, each other; (2) transcendent of organizational (and disciplinary) boundaries; (3) inherently trans-scalar (cannot be explained at a single level of analysis); (4) not able to fit into existing entrepreneurship or strategic management paradigms; and (5) both the origin of change and a response to change. These characteristics correspond with the five factors identified earlier as underdeveloped elements of an SE conceptualization emphasizing control, hierarchy, continuity, and discrete variables (Ireland et al., 2003).

Against a backdrop of movement and interplays, SE entails an entrepreneurial perspective on a world of transient and systemic phenomena—*forms-flows-functions*—that exhibit multilevel and cross-scale dynamics and result in organizational, structural, social, and economic change. Problems in the domain of SE require perspectives from different disciplines to better understand the multiple logics and linked processes that give rise to different opportunity structures. In SE, attention shifts to how entrepreneurial opportunities emerge from entrepreneurship-induced change that arises from interrelated dynamics of self-reinforcing spatial and temporal cycles. Primacy is given to interrelationships and the patterns that emerge from these dynamic relations—not *who* is interacting, but *how* interaction is taking place. The primary goal in SE is to simplify our understanding of relations in the opportunity space, and how these relations change and evolve through a multilevel form of analysis of the processes, events, and structures at each level, as well as how these processes are linked across different levels.

As a self-generating system of innovation, the opportunity space plays a fundamental role in reenergizing the economy at all levels. The structure and functioning of the opportunity space is sustained by feedback between its components and their environment. The environment acts as both constraint and enabler of the growth and development in the subsystems, which in turn modify the environment. Thus SE is the engine of change giving the economy its momentum, confirming Schumpeter's (1942) argument that the mechanisms of economic change pivot on entrepreneurial activity. Schumpeter's progressive succession of creative destruction is a closed loop (based on equilibrium thermodynamics in which energy is conserved) that is self-sustaining and self-reinforcing (path

dependent)—a "vicious" cycle (Ropo & Hunt, 1995). Driven by historical processes, it is constrained by existing world views, resources, routines, and mental models. In contrast, far-from-equilibrium thermodynamics have a positive effect that liberates the system from the dogmas of the past. While innovation (incremental, adaptive, evolutionary) is common, qualitative novelty (frame-breaking or a paradigm change) is a rare occurrence. However, it is the latter that creates the conditions for the former and this constitutes the domain of SE.

The opportunity space, with its temporary opportunity territories and "meshwork-of-an-opportunity," is the unit of analysis within a micro–macro[8] framework. It offers a perspective on the micro dynamics of the relational moves between individual components (bottom-up, distributed, local analysis of individual behavior, and decision making) and the macrodynamics associated with emergent properties (i.e., economic or entrepreneurial opportunities). SE's outcomes are measured in terms of *quantities* (e.g., profit, products), *qualitative differences* (e.g., novelty, potentiality), and *pace* (e.g., rapidity/slowness of rhythms, rates of change in transitions)—wealth creation is not the first priority, but rather the inevitable result of a priority centered upon synergy, diversity, alignment, symbiosis, connectivity, and resonance amid paradoxical tensions such as competitive and cooperative, fast and slow, harmonious and divergent, unified and fragmented, self-similar and infinitely differential, deterministic and chaotic. This represents a shift from SE's current structural and quantitative bias toward a focus on how consequences of change (e.g., innovation and economic opportunities) are shaped, and in turn are shaped by symbiotic flows, emergent forms, and creative functions of participants in the opportunity space, resulting in entrepreneurial opportunities that create change.

A Remapping of Territories: What SE Is *Not*

When approached in this way, SE becomes a conceptual domain that explains and describes phenomena that are not addressed by entrepreneurship, corporate entrepreneurship, strategic management, or evolutionary economics and their respective theories as summarized in Figure 1. McKelvey (2004, p. 330) suggests, "bioevolutionary theory is about equilibrium . . . evolutionary theory is about what happens after blind variation. Population ecology is about what happens after a species is created, not about its creation. Entrepreneurship is about creating blind variation and before selectionist evolution and population ecology." In our view entrepreneurial opportunities are *generated* far from equilibrium, but *individuated* at or near equilibrium; that is, "the entrepreneurial process begins with the perception of the existence of opportunities, or situations in which resources can be recombined at a potential profit" (Shane, 2003, p. 10). Thus the "individual-opportunity nexus perspective" (Shane & Venkataraman, 2000) on entrepreneurship depends on, is preceded by, and is a response to SE. Moreover, in SE entrepreneurship-induced change occurs endogenously, and not through technological innovation as suggested in evolutionary economics (Nelson & Winter, 1982).

8. De Landa (2006, pp. 126–128) explains that a firm and the economy are not by definition the micro- and macro-level, respectively. Rather "at every level of scale we may have, on the one hand populations of micro-entities, populations characterized by intensive properties . . . ; and on the other, some of the members of these populations may be caught into larger macro-entities, regularized and routinized." This means that "designations of micro and macro are relative to each other, and, in particular, to the analytical purpose at hand." Thus, "entities at any given level (the level of nation-states, cities, institutions, or individual decision makers) [are analyzed] in terms of populations of entities at the level immediately below" (De Landa, 2000, p. 18) and "individual decision making affects only one level of scale" (De Landa, 2000, p. 288)—the level immediately higher has its own dynamics.

By extending the established foundations in SE to include a complexity perspective, it becomes more apparent what SE is not. SE should not be thought of as a resource or mindset in an entrepreneurial theory of the firm (Alvarez & Barney, 2007), the entrepreneurship of resource-based theory (Alvarez & Busenitz, 2001), firm-level entrepreneurship (Sharma & Chrisman, 1999), or entrepreneurial behavior of the firm (Covin & Slevin, 1991). Importantly, SE is not a competitive strategy, a characteristic of a strategy, or a strategic approach selected from a portfolio of strategies. It also differs in important ways from entrepreneurial strategy's competition-on-the-edge (Eisenhardt et al., 2000) and co-adaptive exploitation of cross-business synergies (Brown & Eisenhardt, 1997), as well as Lavie's (2006, p. 153) integration of the "inward-looking perspective of the dynamic capabilities literature with the outward-looking technological discontinuities perspective." It is also not about entrepreneurial actions of individuals (McMullen & Shepherd, 2006) or a creation theory of entrepreneurship (Alvarez & Barney).

Simply put, the context is a point of departure that has been taken out of context. SE is not "strategy that is entrepreneurial" or "entrepreneurship that is strategic" or "entrepreneurship plus strategy"—it is *not* a binary construct. Viewing SE through the lens of complexity science provides an explanation of why intersections of strategy or entrepreneurship with other disciplines lead to transformations that are beyond simple interfaces and combinations, creating a "*meshwork of theories*" (De Landa, 2000, p. 330).

Beyond Boundaries: Conclusions, Contributions, and Implications

While the creators of the term "SE" have subsequently attempted to "look inside the black box" (Sirmon et al., 2007) to examine how resources create superior value, we eliminate the boxes (literally and figuratively). By asking how, when, why, when, and where SE occurs, what it is and who practices it, a different point of view comes into focus, one gleaned through the looking glass of complexity sciences. We get surprisingly different answers—taking us in new directions, rather than simply confirming the components of SE as currently conceptualized (e.g., Ireland et al., 2003). What lies at the interface of strategy and entrepreneurship is not a simple fusion. Indeed, what lies "in-between" is a metastable opportunity space—a unit of analysis and a novel organizational form—that uniquely acts as a cross-scale platform for action, a nonhierarchical interface for innovation, and a meshwork of opportunity that reinvigorates both the firm and the economy. It is in this opportunity space that entrepreneurship and strategic management collide with each other to dissolve sharp boundaries—hybridizing, cross-fertilizing, and integrating various fields of inquiry. Thus SE's "black box" lies not with the starting conditions (e.g., individual minds, the firm, its resources, or the environment), the functional endpoint (innovations), or mechanistic connections in between. Rather, SE is fundamentally concerned with the realities confronting decision makers in contemporary contexts—how to harness the creative potential of complex dynamics in a systemic approach that creates, grows, and amplifies value throughout the system.

This study makes at least five potentially important advances. First, SE can indeed be understood as the "two faces of Janus" (Koestler, 1969), but this does not imply a compromise, integration, or balance of bipolar tensions, but the "simultaneous existence of two inconsistent states . . . [a] duality of coexisting tensions" (Eisenhardt, 2000, p. 703). The inherently paradoxical tensions in SE do not merely interact dialectically with each other as a series of oppositions and differences such as exploration and exploitation—they are also interdependent and complement each other in a movement between order and chaos, and between orders, and act as a source of creative potential.

According to Eastern philosophy "yin gives form to the unstable, undifferentiated dynamism of yang"; that is, "activity (yang) is what manifests as form, whereas relationship (yin) is what gives form" (Yuan, 1997, p. 306). Yin and yang symbolize the paradoxical nature of constant change–stability, disorder–harmony, cooperation–competition, or deliberate–emergent. In "both-and" or Janusian thinking, the challenge is to entertain two paradoxical thoughts or practices at the same time. The proposed new paradigm transcends endless scholarly debates about an economy that is either *tending toward* equilibrium (Schumpeter, 1934) or *tending away from* equilibrium (Kirzner, 1973). In SE, *both* tendencies are in dynamic tension, take place at the same time, and occur as a result of emergent processes that differ in terms of their respective ontological and epistemological foundations. Thus, the complex universe of paradoxical tensions operating over different spatial and temporal dimensions do not oppose each other (i.e., addition or subtraction), but instead have a generative effect (i.e., multiplication or amplification) (De Landa, 2000). This enables a fresh perspective on how practices in the domain of SE can be self-generating, self-transformative, and self-sustaining.

Second, SE is currently conceptualized as an entity-oriented term with a set of organized, goal-directed, purposive actions that prioritize cause–effect relations in a static view of dynamic phenomena We reinterpret unquestioned assumptions in SE and propose an alternative that focuses on the generative cycles and internal going-ons *within* the opportunity space rather than firm-level or macrocausal factors that determine outcomes. This moves SE beyond a stage model that reduces change to shifts between stable states (Van de Ven & Poole, 1995) and toward detectable patterns in continuing cycles of interactions. Cycles and relational moves themselves, not their content, is of interest (Tsoukas & Chia, 2002), shifting attention toward more fluid concepts such as relational fields and potentiality.

Third, the source of novelty (as opposed to newness) has not been accounted for theoretically in either strategic management or entrepreneurship research. The notion of an opportunity space provides an explanation for the emergence of novelty—Schumpeter's (2005) important unsolved problem. We believe Schumpeter made assumptions that prohibited him from solving this riddle: (1) methodological individualism (*the problem of different worldviews*); (2) the economy is a closed system (*the problem of simple and complex systems*); and (3) new combinations as mutations (*variation*) and technology as the only source of novelty (*the problem of self-organization and emergence*). A complexity science perspective demonstrates the importance of making a clear distinction between the ontological, epistemological, and analytical levels. It shows how the synergistic cycles in the opportunity space give rise to qualitative novelty (that is unrelated to technological innovation) as an enabler of Schumpeterian development. Additionally, a complexity worldview facilitates distinctions between evolutionary and revolutionary outcomes associated with order of magnitude change, of which only the latter induces structural, social, and cultural change. Importantly, "newness" is not a one-dimensional construct and cannot be used interchangeably with innovation, entrepreneurship, or opportunity-seeking behavior.

Fourth, the proposed 3F paradigm for SE contributes to contemporary debates on new forms of organization that are individualized, project-based, networked, cellular, postmodern, and so forth (Whittington et al., 1999). Others have drawn different distinctions, such as "team entrepreneurship" (Mosakowski, 1998) or "distributed entrepreneurship" (Chandler, 1962). According to Hedlund (1994) the "M-form," which implies a logic of hierarchical organization, built on assumptions and hypotheses like those articulated by Simon (1962), has lost its usefulness. He proposes the N-form as an alternative. Our notion of an opportunity space corresponds with characteristics of Hedlund's (p. 82)

N-form, such as "*temporary constellations* of people and units . . . [and]. . . . *focusing* the corporation on fields with rich potential for combining knowledge elements rather than diversifying to create semi-independent parts." We also extend his conceptualization in two important ways: We (1) get *inside* the system to examine its dynamics; and (2) go *outside* the boundaries of the firm to increase diversity—an approach less teleological and thus more conditional, fluid, and ultimately, more dynamic. Moreover, while the temporal dimension is a regular consideration in studies on processes, space is often neglected. The opportunity space integrates time and space, making it possible to address questions about temporary territories, spatial competition, and interspatial dynamics in spatially dispersed or virtual meshworks.

Fifth, "in the absence of some candidate for a paradigm, all the facts that could possibly pertain to the development of a given science are likely to seem equally relevant" (Kuhn, 1970, p. 15). Rather than merely add a new repertoire to the existing model, we argue that SE is not a simple fusion. Paradoxically, SE is simultaneously distinct from strategic management and integrally part of it, but not in the way strategic management scholars are approaching it. We show how different disciplines can be integrated around the principles of complexity science, thereby creating a new universe of discourse that handles "the same bundle of data as before, but placing them in a new system of relations with one another by giving them a different framework" (Kuhn, p. 85). A complex systems perspective on SE is transdisciplinary—it integrates disciplines, and at the same time it transcends conventional disciplinary demarcations. True to its root, SE is *entreprende*—"in-between"—not a new territory to be colonized.

The postcybernetic, methodologically antireductionist paradigm we propose has a number of implications for the current path of scholarship in SE as it questions the relevance of firm-level theories for SE—most of which are descriptive, static, or focused on interactions and reversible processes. The abstractions in many dominant paradigms oversimplify the complex reality facing decision makers and neglect dynamism as an inherent property of entrepreneurial systems. The unfolding logics of change stand in sharp contrast to a strategic management paradigm that prioritizes control with a preoccupation on reducing uncertainty (Hitt et al., 2001). Ambiguous results from empirical studies confirm the inherent unpredictability in complex systems in which the same components can lead to different outcomes, different actions can be associated with the same results, and the same performance can occur from different components. A complex system perspective implies that uncertainty, complexity, and change are essential components and part of an inevitable dynamic—not undesirable, complicating factors. Without these factors, new worlds would not be possible. This is what catalysts and facilitators in SE thrive on—it is what authoritarian decision makers in hierarchies try to avert. Moreover, SE's most pertinent features are better considered qualitatively, rather than the dominant quantitative approaches that reduce SE to the same set of numbers that are emphasized in strategic management. Thus, we caution against trends in scholarly work (both CE and SE) in which firm growth or superior financial performance is considered the most important yardstick. This trend is partially to blame for the erroneous assertion by scholars that "we should be very, very worried about the future of entrepreneurship" (Baker & Pollock, 2007, p. 307). Key qualitative measures in SE (e.g., novelty, diversity) are not subservient to quantities underlying financial performance (e.g., profit, revenues) or growth (e.g., new products). Rather, if the qualitative features of SE are attained, the likelihood for a substantial payoff increases, even though this might not be immediately apparent. For example, after Amazon.com entered the bookselling industry with a novel business model, its financial performance was atrocious and, for several years, critics doubted the startup's viability, not realizing the presence of a paradigm change. The rest is history.

Second, in a complex and dynamic world where the potential inherent in unanticipated outcomes triumphs "the superhuman role of being the designers of strategy, the architects of structure and the builders of systems" (Bartlett & Ghoshal, 1994, p. 108) becomes obsolete. Companies such as Linux, IKEA, and Cirque du Soleil are premised on a set of basic assumptions by their managers

> regarding organization structure, decision making processes and, ultimately, human behavior, that are significantly different from those that underlie the economic and behavioral theories that currently dominate academic analysis of business organizations. As a result, these theories are of limited usefulness for analyzing the behaviors of, and within, such companies. This is a serious handicap for management scholars and a major reason for the widening gap between existing management theory and emerging management practice (Bartlett & Ghoshal, 1993, p. 25).

Thus, strategic decision-support tools used by managers need to shift from describing easily observable variables to understanding underlying processes that shape change, from Newtonian ideas of control and planning to autonomy and distributed functioning, from finding "right" structure–strategy configurations to fluid linkages and flexible rules, from a strategy for reducing uncertainty to harnessing the dynamic potential of the system; from the "art of war" to the "art of managing complexity"; and from financial performance judgments in pursuit of efficiency to questions about value in pursuit of novelty. These shifts draw attention to ways of unblocking pathways to innovation, building resilience, nurturing diversity, and being comfortable with not knowing. Emphasis is placed on multilayered and adaptive comanagement that centers on emergent roles and collaboration as a way to deal with uncertainty (Armitage et al., 2007). Because solutions evolve through trial and error, a greater tolerance for failure is paramount.

Further, an emergentist perspective has significant implications for entrepreneurship education. Many entrepreneurship scholars receive their training in strategy groups within management departments (Gartner, Davidsson, & Zahra, 2006). However, when it comes to entrepreneurship, educators have to break free from strategic thinking that confines it to economics, perspectives that examine firms as mechanistic entities at equilibrium, treatment of economic actors as rational self-interested individuals and a focus on profit maximizing. An understanding of the ongoing dynamics of interest in SE implies a need for systems thinking in which neither the individual, organization, market, or industry is prioritized. Efforts to strive against the "business as usual" mentality require a shift away from finding simple "right" answers toward finding the "right" problems. The concern is less with the creativity of individuals or how they *think*, and more with *experimentation* and disruption of the dominant order.

The proposed perspective on SE opens up interesting avenues for future research. The authors are examining the logic of emergence as an alternative to a logic of control (Sarasvathy, 2001) to overcome built-in restrictions of Austrian economics and a behavioral theory of the firm. Additionally, there are many unanswered questions about processes operating within the opportunity space, and the extent to which system-wide change, rather than systematic change of individual system components, results in more advantageous outcomes. A third avenue arises from potential parallels between the activities and practices of movement creation in SE and the extant social movement literature. Theories on how to coalesce revolutionary participation or set revolutionary momentum in motion may prove a better fit than the resource-based view, especially when the objective is to better understand how organizations mobilize resources to become a force for change rather than a victim of change.

The current work highlights a number of methodological challenges for future research at a time when cross-sectional analysis is privileged over complex process research. Instead of treating "complexity" as a mere metaphor, a mathematico-physical construct, or a shift from a modernist to a postmodernist worldview (Cilliers, 1998), the new paradigm requires consideration of "the right question to ask, as the most relevant way of posing problems" (Mackenzie, 2005, p. 48). Specifically, "[c]an we use what present themselves today as 'complex objects' to underline the general problems they raise, rather than the particular models of solution they determine?" (Stengers, 1997, p. 5)—that is, problem finding, rather than problem solving. Her comment highlights Jonah's Paradox: if you can predict the course of history dependably, innovation must be impossible; if you can innovate, your predictions are irreducibly uncertain (Winder, 2007). Thus the emergent nature of phenomena in SE requires that questions are asked differently—from *how/why*? to *what if*? (Ravetz, 2007). Moreover, complex mixtures of multiple dynamics may need to be studied in bottom-up simulations (Brown & Eisenhardt, 1997).

In conclusion, consistent with its theme of paradigm shifting that becomes possible in unfamiliar territory at "the Intersection" (Johansson, 2006), we echo the pleas of other scholars for a fundamental shift in thinking about entrepreneurship (and by extension, SE) by removing the shackles of its roots and opening it up to new possibilities. Steyaert (2005, p. 7) proposes that entrepreneurship be viewed not as an emerging discipline but as "a fertile middle space, a little chaotic and unfocused arena, a heterotopic space for varied thinking, a space that can connect to many forms of theoretical thinking and where many thinkers can connect to, a 'true' inter-discipline." Our conceptualization reinforces his view, but extends it further to become boundary-crossing with various continua that allow for movement from one theoretical standpoint to another. Thus, we offer our perspective in the hope that it is provocative. As Pettigrew et al. (2001, p. 698) note: "In the process of knowledge production, intellectual diversity is a more attractive and possibly more effective scholarly goal than is intellectual closure."

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