

FGF Studies in Small Business and Entrepreneurship

Elisabeth S.C. Berger
Andreas Kuckertz *Editors*

Complexity in Entrepreneurship, Innovation and Technology Research

Applications of Emergent and Neglected
Methods

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About the FGF Studies in Small Business and Entrepreneurship

Understanding entrepreneurship and entrepreneurial phenomena in new ventures, small businesses, and established corporations is of crucial importance for entrepreneurs, corporate managers, and policy makers alike. Since its inception in 1987, the *Förderkreis Gründungsforschung e.V. (FGF)* has strongly supported the development of research on these important topics and is today the largest and leading association of entrepreneurship and innovation scholars in Germany, Austria, Switzerland, and Liechtenstein. Today, the *FGF* provides an established platform for the exchange of ideas and new results from entrepreneurship research and related phenomena such as innovation, small and medium-sized enterprises (SMEs), and family businesses. One important medium for the exchange of knowledge is the book series “*FGF Studies in Small Business and Entrepreneurship*.”

The aim of this peer-reviewed book series is to showcase exceptional scholarly work in small business, innovation, and entrepreneurship research. The book series has an interdisciplinary focus and includes works from management, finance, innovation, marketing, economics, sociology, psychology, and related areas reflecting the breadth of different approaches to small business and entrepreneurship research. Volumes in the series may include

- research monographs,
- edited volumes, and
- handbooks or quick reference books.

The book series *FGF Studies in Small Business and Entrepreneurship* acknowledges that small business and entrepreneurship phenomena occur at various levels of analysis and hence the series is concerned with a plethora of levels including the analysis of individuals, organizations, networks, economies, and societies. Through this, the book series serves as a vehicle to help academics, professionals, researchers, and policy makers, working in the fields of small business and entrepreneurship, to disseminate and obtain high-quality knowledge.

Proposals for new titles in the series are extremely welcome and should be addressed to one of the two editors-in-chief.

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The Challenge of Dealing with Complexity in Entrepreneurship, Innovation and Technology Research: An Introduction

Elisabeth S.C. Berger and Andreas Kuckertz

Abstract Complex systems seem to be all around us and the world, economies and businesses apparently become more complex every day. This is especially true for phenomena in entrepreneurship, innovation and technology research. This introductory chapter elaborates our understanding of complexity and explores the interdependencies in entrepreneurship, innovation and technology research with regard to complexity. When studying complexity it is essential to apply research methods that consider the non-linearity, dynamics and interrelatedness inherent in complexity. However, appropriate methods are frequently neglected or not yet established among the plethora of available research methods. This volume adds to the visibility of the application of emergent and neglected methods in the context of complexity in entrepreneurship, innovation and technology research. Finally, the chapter provides an overview of the contributions in this book.

Keywords Complexity • Entrepreneurship • Innovation • Research methods • Technology

1 Defining Complexity

Complexity, complex systems, complex theory or science of complexity are terms which have a long history. However, there appears to be neither a consistent definition or a well described science or theory. In this book, we take the perspective of the broadest possible understanding of complexity originating from the Latin word *plectere*, which refers to parts of a system being entwined (Mitchell, 2009). Those large number of parts might be in itself simple, but are irreducibly interlinked to each other and thus create what is referred to as a complex system that is “more

“Fools ignore complexity. Pragmatists suffer it. Some can avoid it. Geniuses remove it.” Alan J. Perlis (1982)

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than the sum of its parts” (Simon, 1962, p. 468). According to Lichtenstein (2000), four assumptions characterize such complex systems:

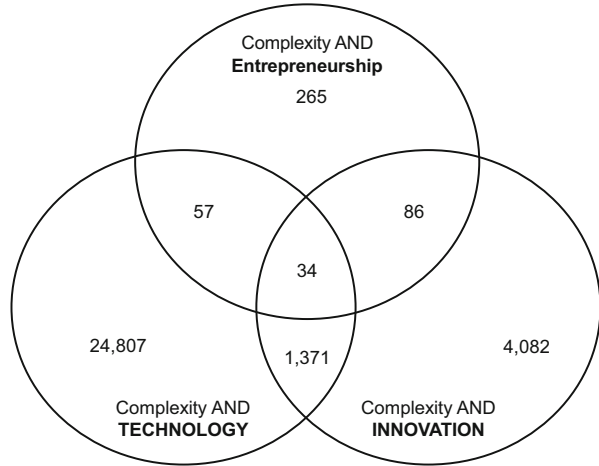
1. Dynamics—Complex systems are dynamic and constantly changing.
2. Irreducibility of elements—Due to the entwined nature of the elements, it is insufficient to focus on the effects of the single elements as the system as such cannot be reduced to them.
3. Interdependencies—The causality in complex systems cannot be described by linear models, as the causality is interdependent.
4. Non-proportionality—The effect of an antecedent or input factor is not proportional to the strength of that antecedent. Due to the non- or disproportionality, small inputs might have a large impact, whereas large inputs might hardly change the outcome.

Based on this characterization, complex systems seem to be all around us and the world, economies and businesses are only becoming more complex, as many reports attempting to measure the increasing degree of complexity in economies and businesses show (Hausmann et al., 2011; MediaMind Research, 2013). Especially since more and more interactions involve the internet, which is a complex system in itself, some even argue we are in fact dealing with sets of complex systems (Park, 2005). In sum, it appears to be inevitable for researchers to acknowledge and study complexity. Likewise a large part of social science including management science has consequently embraced the so-called “complexity turn” (Urry, 2005). This is also true for practitioners given that growing complexity increases the need for control to a more than proportionate amount, which is a key challenge in management.

2 Complexity and Interdependencies in Entrepreneurship, Innovation and Technology Research

The thematic focus of this edited volume is primarily on entrepreneurship. Yet, entrepreneurship as a fairly new field has many interfaces with neighboring disciplines, which is especially true for innovation and technology. All three fields naturally interlock (Kollmann, Kuckertz, & Stöckmann, 2010). As Mitchell (2009, p. xii) points out, when we seek to study complexity “lines between disciplines begin to blur”. Therefore, we do not seek to create an unnatural separation by focusing on complexity in entrepreneurship research alone, but rather embrace the blurred lines to innovation and technology research. However, even this extended focus might appear as a fuzzy demarcation. Therefore, concepts, insights and methods discussed in this volume will surely not only touch on the three disciplines separately but also create parallels with them and possibly be an inspiration for other disciplines.

Fig. 1 Number of publications for search terms on *Web of Science*TM



In order to show how the research domains of entrepreneurship, innovation and technology research are actually intertwined, we analyzed the number of publications appearing in the *Web of Science*TM *Core Collection*¹ applying the following search terms:

- Complexity AND Entrepreneurship
- Complexity AND Innovation
- Complexity AND Technology
- Complexity AND Entrepreneurship AND Innovation
- Complexity AND Entrepreneurship AND Technology
- Complexity AND Innovation AND Technology
- Complexity AND Entrepreneurship AND Innovation AND Technology

The results of this analysis are depicted in the Venn diagram in Fig. 1. Note that the size of each circle is not adjusted for the magnitude of the respective domain.

The link between complexity and technology appears to be very pronounced resulting in 24,807 publications since 1972. The number of publications has dramatically increased since the 1990s and reflects how complexity science has borrowed from technology research and vice versa in their development. In innovation research, there have been 4082 publications since 1979 which can be attributed to the interface of complexity and innovation. Whereas in the 1980s and 1990s only a few manuscripts were published, the number has picked up significantly since the 2000s.

The theoretical relevance of complexity in innovation research is stressed in a recent paper by Poutanen, Soliman, and Stähle (2016, in press). The authors provide a literature review showing how researchers in innovation are increasingly adapting

¹ As per September 2015.

a complexity approach to study the innovation process and how this approach helps to understand the interactions of actors involved in the innovation process a lot better. Furthermore, the authors call for moving from a linear understanding of innovation processes to embracing complexity by accepting non-linear, dynamic and interrelated causality.

Complexity and entrepreneurship has led to 265 publications since 1992, most of them appearing after 2005. The seminal work by McKelvey (2004) has contributed strongly to the growing attention of complexity by entrepreneurship scholars.² In this study the author lays out how entrepreneurship is a naturally complex system, as it focuses not on equilibrium but rather on creating order. Accordingly, it is appropriate if not necessary to study entrepreneurial phenomena applying complexity science.

However, while this analysis might give a rough idea of how popular or how closely related complexity and those three research areas are, comparing absolute numbers of publications only provides limited insights for two reasons. Firstly, the research areas are in different stages with regard to age and maturity, which leads to naturally more publications in technology research as the oldest discipline among those three. Secondly, the number of publications might not necessarily reflect the interest in complexity but also the ability or inability to study complex systems.

Yet, a strong link is evident when focusing on the intersection of publications, which relate to complexity and entrepreneurship and innovation or technology. 32 % of the complexity and entrepreneurship publications are also in the area of innovation, the same is true for 22 % of the intersection with technology research. These results reinforce Mitchell's argument (2009) of blurred lines between disciplines with regard to complexity and emphasize the suitability of including innovation and technology research when studying complexity in entrepreneurship.

3 The Need for New Research Methods

Research needs to contemplate the interplay between the studied phenomenon, the considered theory and the methods employed and align those three areas. This is especially crucial when studying complex phenomena as the underlying assumptions such as non-linearity and dynamics are not in accordance with the most common research methods. Despite an increasing degree of complexity in strategic management, for instance, the application of linear models is still the most prevalent research approach (Shook, Ketchen, Cycyota, & Crockett, 2003). However, research which seeks to study the interlink between complexity theory and entre-

² 23 of the 233 articles published since 2005 which address the interface of entrepreneurship and complexity have cited McKelvey (2004).

preneurship, innovation and/or technology research, needs to acknowledge the implications of complexity theory in the entire research design. In consequence, new methods need to follow new theory (Ketchen, Boyd, & Bergh, 2008). By doing so, applying new or neglected methods also exhibits the potential of fostering the development of new methods (Van Maanen, Sørensen, & Mitchell, 2007).

Yet, the application of new methods and getting those past the review process and published can be a challenging endeavor for several reasons. We refer to emergent methods as research methods, which are not yet well established, hence cookbook like instructions are likely not to be available yet. Instead, researchers applying new methods need to be flexible, open for changes, sometimes creative and willing to take some risk. Researchers frequently develop new methods from modifications of existing ones, thus going to the edge and exploring the borders of established methods is another quality needed to apply and develop new methods. New methods are going to drive scholars out of their comfort zone and possibly raise justified questions concerning validity and reliability. However, this is only one part of the story of emergent methods, the other half involves the review process and hence the gatekeepers to publications. Reviewers might likewise have a tendency to disapprove of new methods, simply because they are not familiar with them. This is even a greater challenge for reviewers, if the new method is not related to conventional linear models, such as methods which capture complexity (Hesse-Biber & Leavy, 2010). Even if this might cause a lot of frustration on the researcher's side, in early stages of a method researchers are thus forced to spend large sections on explaining the methods and appropriateness for the research design. Another approach might be to run linear analysis and to emphasize how the results fail to mirror the interactions in place.

Following this argumentation, we refer to neglected research methods as those, which might have been developed a while ago, but are still not fully developed or applied frequently. Nevertheless, the neglected methods could exhibit the potential to capture complexity appropriately but might need to be further developed to become established. However, that does not mean that their negligence is justified.

A study by Kuckertz and Mandl (2013) explores the current and potentially future methods in entrepreneurship research. Accordingly, regression analysis is rated as the most fundamental method in entrepreneurship research scholars should be familiar with, but is inappropriate for studying complex systems. The methods entrepreneurship researchers are currently interested in lists structural equation models, case study analysis, network analysis, action research and experimental designs as the top five. Some of those are indeed appropriate to study complex phenomenon and hence this list offers cause for encouragement, that we will find a broader variety of methods being applied and also more studies which embrace complexity with appropriate methods. As Shook et al. (2003) point out, in order for future researchers to apply methods which are capable of accounting non-linearity, dynamics and interrelated causality this also needs to be taught to doctoral students and requires reviewers to be open-minded and favorable towards the application of new methods.

4 Goals and Structure of this Volume

This volume aims at providing a forum for the discussion of emergent and neglected methods in the context of complexity in entrepreneurship, innovation and technology research and also at developing to be a standard reference in the rising field of the application and advancement of those methods. We hope that this volume adds to the visibility of those useful methods and also acts as an encouragement for other researchers and other disciplines to engage more into complexity and apply appropriate research methods to do so.

In order to assemble a rich, vibrant and multi-faceted collection of studies applying methods able to capture complexity and bringing together diverse perspectives, this volume comprises different theoretical concepts and methods. To ensure high standard contributions, all chapters went through a rigorous double-blind review process. The edited volume consists of 21 chapters arranged in four parts: (I) Methodological and Conceptual Discussion, (II) Qualitative Methods, (III) Configurational Methods, and (IV) Semantic Methods.

Part I of this book focuses on the methodological and conceptual discussion around complexity in entrepreneurship, innovation and technology research. The first chapter by Najmaei “Using Mixed-Methods Designs to Capture the Essence of Complexity in the Entrepreneurship Research” might be viewed as an extension to this introduction as it expands on the review of complexity theory. Furthermore, the author argues for the application of mixed methods in order to capture complexity in entrepreneurship research. Mühlenhoff follows Najmaei’s line of argumentation in chapter “Applying Mixed Methods in Entrepreneurship to Address the Complex Interplay of Structure and Agency in Networks” by stressing the relevance of integrating qualitative and quantitative approaches when studying complex entrepreneurial networks. The third chapter by Schlaile and Ehrenberger titled “Complexity, Cultural Evolution, and the Discovery and Creation of (Social) Entrepreneurial Opportunities” studies the phenomenon of social entrepreneurship and explores the extent to which a memetic perspective might be appropriate to understand this complex system. The following three chapters focus on the conceptualization of complex systems in entrepreneurship. Liening, Geiger, Kriedel, and Wagner (chapter “Complexity and Entrepreneurship: Modeling the Process of Entrepreneurship Education with the Theory of Synergetics”) suggest that the complex process of entrepreneurial education, which is known to be a very vibrant field (Kuckertz, 2013), might be well modelled by applying theory of synergetics, a complexity theory of self-organization. In chapter “Computer Simulation Studies of the Entrepreneurial Market Process” Keyhani elaborates the strengths of applying computer simulations to complex entrepreneurial phenomena by reviewing three recent studies. In the subsequent chapter “Analyzing Complex Organizational Arguments with Logical Model Building” Péli makes a case for applying logical model building in order to analyze complex organizational arguments as this method allows researchers to draw exact conclusions from complex arguments.

In Part II we turn to the application of emergent and neglected research methods and present a wide spectrum of studies applying qualitative research methods to capture complexity in entrepreneurship, innovation and technology research. In an introductory chapter to this part of the book Wenzel, Senf, and Koch (chapter “Exploring Complex Phenomena with Qualitative Research Methods: An Examination of Strategic Innovation Trajectories in Haute Cuisine”) provide guidance to scholars by arguing for the application of qualitative methods to discuss complexity and by introducing an analytical approach to scrutinize complex phenomena based on qualitative data. Lastly, the authors illustrate the advantages of the analytical approach by providing an exemplary application. Chapter “Effectuation and the Think-aloud Method for Investigating Entrepreneurial Decision Making” by Frigotto discusses the complex phenomenon of entrepreneurial decision making from an effectuation perspective by showing the potential of the thinking-aloud method in an illustrative study. In the subsequent chapter titled “Applying Factorial Surveys for Analyzing Complex, Morally Challenging and Sensitive Topics in Entrepreneurship Research” Dickel and Graeff make a case for disentangling effects of interrelated variables by applying factorial survey in the context of entrepreneurial ethics. To do so, the authors review the methodological approaches taken previously in entrepreneurship ethics and illustrate the advantages of factorial surveys by providing a sample vignette study. Felden, Fischer, Graffius, and Marwede illustrate in the tenth chapter (“Illustrating Complexity in the Brand Management of Family Firms”) complexity in entrepreneurship by merging two research areas, namely family research and brand management, which are usually studied unconnectedly. The authors show how the more complex consideration of the phenomenon can provide new insights to theory and for practitioners. In chapter “A Systematic Approach to Business Modeling Based on the Value Delivery Modeling Language”, Metzger, Kraemer, and Terzidis illustrate the application of Value Delivery Architecture Modeling, a new approach to deal with the challenges associated with studying complex value creation networks. Action research is the only example of a neglected qualitative research method. However, Schultz, Mietzner, and Hartmann argue that this method is indeed appropriate to analyze complex systems in entrepreneurship in chapter “Action Research as a Viable Methodology in Entrepreneurship Research”.

Part III embraces studies applying configurational methods, mainly qualitative comparative analysis (QCA), but also cluster analysis to study complexity in entrepreneurship. Again as an introduction to this part of the volume, Berger (chapter “Is Qualitative Comparative Analysis an Emerging Method?”) provides an analysis of the maturity of QCA applications in business and management research by conducting a structured literature review and a bibliometric analysis (see Kuckertz, Berger, & Mpeqa, 2016, in press, or Kuckertz, Berger, & Allmendinger, 2015, for recent applications). In chapter “The Complex Determinants of Financial Results in a Lean Transformation Process: the Case of Italian SMEs”, Camuffo and Gerli give an example of applying QCA to explore the

complex determinants of financial results in a lean transformation process, when applying OLS did not lead to satisfactory results to answer the research question. Roig-Tierno, Mas-Tur, and Ribeiro-Navarrete illustrate in chapter “Young Innovative Companies and Access to Subsidies” the strength of QCA to study complexity by comparing the results of a previous regression analysis to the configurations that result from a QCA. In the subsequent chapter “Applying QCA and Cross-impact Analysis to the Study on ICT Adoption and use by Croatian SMEs”, Ceric and Krivokapic-Skoko show with an empirical example how QCA can be developed further towards in-depth case analysis by identifying potential areas of alignment with cross-case analysis. Szklarczyk and colleagues (chapter “Configurational Analysis in the Evaluation of Complex Public Programs”) demonstrate the dynamics of emergent methods as they employ qualitative comparative analysis as a starting point to develop a new approach for data analysis in the area of knowledge transfer. In chapter “Entrepreneurial Orientation and the Handling of Complexity in Small and Medium Enterprise Research”, Braun and Steger apply another configurational method, namely cluster analysis to explore entrepreneurial orientation in small and medium-sized enterprises.

The final part of this edited volume draws to the application of semantic analysis to study complex phenomena. Kuckertz and Mandl (chapter “Capturing the Complexity and Ambiguity of Academic Fields”) apply content analysis in order to disentangle two research areas, which are strongly intertwined and offer definitions of small business research, entrepreneurship and their shared interface. Grønning looks in chapter “What do Organizations Think are Their Risks and Uncertainties? Risk Self-assessments within Securities Reports as a new Source for Entrepreneurship, Innovation and Technology Research” at the step of data collection in the research process in entrepreneurship, innovation and technology research and introduces securities reports submitted to the authorities as a new kind of source for relevant information and provides suggestions how the security reports might be used in future studies. In the final chapter (“Complexity of Textual Data in Entrepreneurship and Innovation Research”), Schuelke-Leech and Barry explain the sources of complexity associated with text in entrepreneurship and innovation research. In order to deal with the complexity of texts and produce a nuanced view, the authors apply text data analytics using corpus and computational linguistics.

Taken together, these 21 chapters form a rich, vibrant and multi-faceted volume discussing and applying methods to capture complexity in entrepreneurship, innovation and technology research. We thank all authors for their excellent contribution, and are also indebted to all of them who have acted as reviewers. Additional reviews were provided by Rene Mauer, Patrick Roehm and Christian Walter. Prashanth Mahagaonkar at Springer impressed us with his incredible support. Furthermore, we are more than thankful to Sven Jagusch for his effort regarding the layout of this edited volume.

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Part I
Methodological and Conceptual Discussion

Using Mixed-Methods Designs to Capture the Essence of Complexity in the Entrepreneurship Research: An Introductory Essay and a Research Agenda

Arash Najmaei

Abstract Although entrepreneurship is recognized as a complex field, existing research does not pay enough attention to capturing the essence of its complexity. I argue that mixed methods designs offer a solid foundation for bridging this gap. To build my argument, I review the key assumptions and dimensions that make entrepreneurship a complex scientific field, discuss the structure of complexity and compare and contrast different research paradigms in terms of their ability to capture complexity. I will then show that mixed methods designs based on the pragmatic paradigm are philosophically better suited than mono-method designs to capture complex phenomena in entrepreneurship. The paper concludes with an integrative framework to guide research and practice along this direction and discusses the implications of this view for studying complexity in entrepreneurship.

Keywords Complexity theory • Mixed-methods design • Pragmatism

1 Introduction

Entrepreneurship research is the “scholarly examination of how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited” (Shane & Venkataraman, 2000, p. 218). Entrepreneurship involves various forms of activities embedded in social systems that take place across different levels and are performed by a single person or a team of individuals within established or new firms (McMullen & Shepherd, 2006). Hence, it represents a system of interdependent factors whose understanding is riddled with complexity.

Dismantling complexity requires the ability to decipher interactions among components of a system (Simon, 1962). Traditional attempts to explain complex phenomena have been either to explore underlying mechanisms or processes via

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interpretive qualitative approaches based on the logic of inductive reasoning or to examine the direction and significance of causal relationships between a set of variables via quantitative methods based on the deductive logic.

Both approaches would generate incomplete insights that, at best, offer a partial picture of the reality of entrepreneurship. Take for example studies on the nature of entrepreneurial opportunities (Dimov, 2011; Patzelt & Shepherd, 2011). Entrepreneurial opportunities are complex entities whose formation and exploitation depend on numerous contextual, cognitive and structural factors (Wood & McKelvie, 2015). Qualitative methods can shed light on the processes involved in the formation and exploitation of opportunities. Quantitative methods can, on the other hand, illuminate causal relationships that explain or predict formation and/or exploitability of opportunities. Such mono-methodical approaches are informative but incapable of producing outputs that are both exploratory—as in the qualitative methods (Neergaard & Ulhøi, 2007)—and descriptive or predictive—as in the quantitative methods (Mingers, 2006). Therefore, it is not surprising to see that entrepreneurship is gradually passing the point where we simply examine its inherent complexity by adopting mono-methodical mindsets. In sum, mono-methods research cannot fully capture complexity in entrepreneurial phenomena for at least two reasons: (1) it is based on a set of limited assumptions about the reality of the phenomenon of interest. (2) It is constrained by a set of methods that either generate context-specific inductively derived facts or result in generalizable less context-relevant deductively-produced results among a limited number of factors. Supporting this view, Anderson (1999) argues that, “simple boxes-and-arrows causal models are inadequate for modeling systems with complex interconnections and feedback loops, even when nonlinear relations between dependent and independent variables are introduced by means of exponents, logarithms, or interaction terms” (p. 216).

In light of the above, the key thesis of this chapter is to revisit the methodological side of entrepreneurship by endorsing the idea that mixed-methods designs (MMDs) open new doors to explore different aspects of complexity in entrepreneurship. MMDs adopt a pluralistic and pragmatic view in which qualitative and quantitative data and methods can be combined to create meta-inferences to paint a more complete picture of complex realities (Creswell & Clark, 2007). Because MMDs take many forms from concurrent and sequential, and from qualitative or quantitative dominant (Creswell, Clark, Gutmann, & Hanson, 2007), they afford a great deal of flexibility to the researcher whose primary goal is to draw a more complete picture of the complexity surrounding entrepreneurial phenomena.

The remainder of this chapter is organized as follows. First, an overview of the entrepreneurship research with a specific attention to its dimensions and evolutionary path into a complex multidisciplinary field will be provided. Then, the mono-methodical view will be discussed and its inadequacy and shortcomings for studying complexity in entrepreneurship will be illuminated. Next, I will argue that the preponderance of mono-methods research has largely been caused by an overreliance on traditional philosophical assumptions that are now shifting towards a pragmatic mixed-methods worldview which is more apt to capture complex realities. Subsequently, the role of mixed methods research in complexity science

will be briefly reviewed and an agenda and a guiding framework for future research on the complexity of entrepreneurship using MMD will be proposed.

I hope this chapter will help entrepreneurship scholars escape from the monomethodical straitjacket in order to tackle the complexity of entrepreneurship by generating a richer and more complete understanding of by who, why, how, when, and under what conditions various entrepreneurial activities are carried out.

2 Entrepreneurship and Complexity: An Overview

2.1 *History of the Entrepreneurship as a Field of Scientific Inquiry*

The scientific field of entrepreneurship is an expansive body of literature formed around three concepts of “entrepreneurship,” referring broadly to the set of activities carried out by an entrepreneur or a field that studies, “entrepreneur(s)” as the agent (individually or in teams) who perform these activities and “entrepreneurial,” as the qualifying characteristics or attributes that capture the essence of these activities. Entrepreneurship has its roots in economics. In fact, the notion of entrepreneurship is as old as economics itself (Cole, 1946; Soltow, 1968). The contemporary literature attributes the current understanding of entrepreneurship to the works of Schumpeter (1934), Kirzner (1973), and Knight (1921). It is to be noted that many others including McClelland (1965) and Gartner (1988) have also made impressive contributions to the field of entrepreneurship (see Landström, 2007 for a comprehensive review),¹ however, consistent with McMullen and Shepherd (2006) I focus on Schumpeter, Kirzner and Knight as pioneers of the theory of entrepreneurship and entrepreneurial activities.

Knight famously conceptualized entrepreneurs as bearers of uncertainty. He distinguished risk from uncertainty by defining uncertainty as incalculable risk. According to Knight, individuals who tolerate uncertainty in hope of gains are entrepreneurs who define and change markets. Schumpeter, on the other hand, was interested in the new theory of capitalism and economic prosperity based on the processes of change and innovation. He proposed that economic wealth is not created by capital accumulation; rather it is generated by innovative activities that use capital in new ways. He called these new ways “new combinations” (Schumpeter, 1934, p. 377) and famously proposed the idea that entrepreneurs drives markets by creating new configurations of asset and destructing the old ones—the process that is famously known as creative destruction. He also distinguished between five types of innovations: new products, new methods of production, new sources of supply, exploitation of new markets, and new ways to organize

¹ I thank an anonymous reviewer for this point.

business or new business models. Accordingly five forms of Schumpeterian entrepreneur can form in markets each requiring a complex configuration of assets.

Schumpeterian ideas were further developed by Austrian economists and most notably Kirzner (1973). According to Kirzner, entrepreneurship is all about discovering and exploiting previously unexploited opportunities by using new combinations of resources. Therefore, Kirzner (1973) shifts the focus of attention from new combinations to opportunities and advocates the study of entrepreneurship as a process rather than an outcome (innovation in Schumpeter's view) (Foss, Klein, Kor, & Mahoney, 2008). According to this view, some individuals have some behavioral or personal elements that enable them to be alert to opportunities and thus they can be called "entrepreneurs." He further assumed that the actions of entrepreneurs lead to a better allocation of resources. By analogy, entrepreneurship leads to better allocation of resources in a market economy (Kirzner, 1973), making entrepreneurship the most important force in today's markets.

Since these classical works, the study of entrepreneurs and entrepreneurship has undergone a metamorphosis (Shane, 2000). The contemporary model of entrepreneurship represents a growing multidisciplinary field that centers on opportunities, risks, innovation and management of complex actions to allocate resources to all sorts of value-creating activities. Therefore one of the most striking challenges faced by students of entrepreneurship is to map the boundaries of the expansive realm of entrepreneurship (Foss et al., 2008; Shane, 2000). In an attempt to define boundaries of this field Shane and Venkataraman (2000) defined entrepreneurship as "the scholarly examination of how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited." (p. 218). This definition is reductionist in that it reduces the domain of entrepreneurship to the nexus of two phenomena: the presence of lucrative opportunities and the presence of enterprising individuals who act alone, in teams or on behalf of small or large organizations to exploit those opportunities. Entrepreneurial opportunities are, hence, the most fundamental component of entrepreneurial activities (Dimov, 2011).

Opportunities in this sense 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). Opportunities arise either in an idiosyncratic manner as a result of errors and omissions of others that cause surpluses and shortages (Casson, 1982), or are the result of technological, political, regulatory, socio-demographic, perceptual, and other unexpected changes in the environment (Korsgaard, Berglund, Thrane, & Blenker, 2015; Patzelt & Shepherd, 2011). Consequently, entrepreneurship involves the study of numerous interacting factors including sources of opportunities; the processes of discovery, evaluation, and exploitation of opportunities; and the set of individuals, the team of corporate actions and social, economic and regulatory factors and conditions that enable or inhibit formation, discovery, evaluation, and exploitation of opportunities (Shane & Venkataraman, 2000). Further, opportunities and associated gains exist in different contexts. For instance, it is already well known that if entrepreneurship is to exploit opportunities for social and environmental gains rather than commercial it becomes

social or sustainable entrepreneurship (Patzelt & Shepherd, 2011). If it is to make better use of political and public resources for the benefit of the society it then becomes political or public entrepreneurship (Lewis, 1988).

In light of the above, it is obvious that entrepreneurship involves various factors at different levels from individuals to socio-environmental and economic into political and regulatory ones. Similarly, as a scientific field it has numerous foci ranging from identification of factors that link entrepreneurs to opportunities, to types of opportunities, types of gains and mechanisms that enable or prohibit these processes. The next section shows that such phenomena and associated fields are complex systems. Accordingly, my thesis is that, entrepreneurship in all its glory as both a multifaceted phenomenon and as a scientific field of inquiry can be best viewed through the lens of complexity.

2.2 *Complex Systems and the Science of Complexity*

The term ‘complexity’ comes from the Latin word ‘complecti’ that translates to grasp, comprehend, embrace (Israel, 2005). Complexity connotes the opposite of simplicity. That is, the world is fundamentally simple and the purpose of any scientific inquiry is to explain it in terms of simple constituent elements (Israel, 2005). To understand the importance of this positioning we need to look at two perspectives that dominate the way scientists look at the world. Let’s consider the world around us and phenomena within it as open systems of factors that interact with each other and with their surroundings. Holism is a viewpoint that stresses the behavior of the whole system and seeks explanation in the identification of the simplest explanatory principles (Malansona, 1999). On the contrary, reductionism seeks explanation through the isolation of parts and examination of interactions between pairs of parts (Malansona, 1999).

Although both views are informative they create, at best, only an incomplete understanding of the behavior of a system. Reductionism does not lead to simple principles for the general behavior of a system and holism cannot distinguish among alternative configurations of the building blocks of a system (Malansona, 1999; Stacey, 1995). Thus, both views ideally offer complementary insights into the behaviors of complex systems (Fontana & Ballati, 1999). Furthermore, both views are inherently concerned with the equilibrium or a tendency towards stability, predictability and regularity (Stacey, 1995). That is an unrealistic and over simplistic assumption because many physical, behavioral and social systems are dynamic and largely unpredictable because they are complex. Herbert Simon (1962) defines a complex systems as:

...made up of a large number of parts that interact in a non-simple way. In such systems, the whole is more than the sum of the parts, not in an ultimate, metaphysical sense, but in the important pragmatic sense that, given the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole. (p. 468)

In the language of complexity, “an in-principle reductionist may be at the same time a pragmatic holist” (Simon, 1962, p. 468). Therefore, when dealing with complex systems scientific inquiries are to be guided by the science of complexity² (Anderson, 1999). The science of complexity is the science of complex systems. It aspires to explain how simple processes and interactions derived from reductionism can combine to generate complex holistic systems that interact and coevolve with their surrounding environments (Malanсона, 1999). The more complex a system becomes the less knowable it gets (Perrow, 1967).

2.3 General Attributes of Complex Systems

The science of complexity makes four important predictions. First, complex systems are usually hierarchical. This is, composed of “of interrelated subsystems, each of the latter being, in turn, hierarchic in structure until we reach some lowest level of elementary subsystem”(Simon, 1962, p. 468). Second, hierarchical systems not only are easier to study and decompose but also can evolve more efficiently and quickly than non-hierarchical systems of comparable size, making them more interesting for evolutionary investigations (Anderson, 1999; Perrow, 1967; Simon, 1962; Stacey, 1995). Thirdly, looking at hierarchies in complex systems, we realize that in general, interactions among elements within subsystems are more intense and frequent than those of between subsystems make them easier to decompose. This attribute is known as near-decomposability (Simon, 1962) and implies that in the “short-run the behavior of each of the component subsystems is

² Interest in studying systems is not new. The holism-reductionism view emerged after WWII which was then completed by Cybernetics and the general system theory (GST). Cybernetics is the study of closed linear feedback loops between a system and the environment [see for example Ashby, R. (1956). *An introduction to cybernetics*. London, United Kingdom: Chapman and Hall] and general system theory is a more complete theory of general systems such as open, close, simple and relatively complex systems in which the linearity assumption between feedback loops and the environments is relaxed [see for example von Bertalanffy, L. (1968). *General system Theory: Foundations, development, applications*. New York, NY: George Braziller]. Ecology theory also addresses the conflict between holism and reductionism by looking at hierarchies in systems but is limited only to middle-number systems those in which component are too many to represent individually and too few to capture statistically in causal models [see Malanсона, G. P. (1999). Considering complexity. *Annals of the Association of American Geographers*, 89(4), 746–753]. So complexity theory represents the most appropriate lens to look at complex systems. Another interesting point is the main difference between normal science (Descartesean scientific method), complexity theory and chaos theory. Normal science explains how complex effects can be understood from simple laws by breaking systems into components and examines them independently using competing theories and add them together in linear fashions to get to the system behavior. Chaos theory, however, stresses the importance of nonlinear relationships and explains how simple laws can have complicated, unpredictable and radically big consequences for the system and the environment. Finally, Complexity theory also subscribes to the nonlinearity of cause and affects and describes how complex causes can produce simple effects.