ESSAYS ON ENTREPRENEURIAL COGNITION, INSTITUTION BUILDING AND INDUSTRY EMERGENCE

ESSAYS ON ENTREPRENEURIAL COGNITION, INSTITUTION BUILDING AND INDUSTRY EMERGENCE

ESSAYS OVER ONDERNEMEND DENKEN,
HET CREËREN VAN INSTITUTIES EN DE OPKOMST VAN INDUSTRIEËN

Thesis

to obtain the degree of Doctor from the
Erasmus University Rotterdam
by command of the

Rector Magnificus
Prof. dr. R.C.M.E. Engels

and in accordance with the decision of the Doctorate Board.

The public defence shall be held on
5 September 2019 at 11:30 hours

by

Katrin Marike Smolka
born in Hamburg, Germany

Erasmus University Rotterdam

Doctoral Committee

Doctoral dissertation supervisors: Prof. dr. P.P.M.A.R. Heugens
Prof. dr. J.P. Cornelissen

Other members: Prof. dr. M. Gruber
Prof. dr. V.J.A. Van De Vrande
Dr. J. Gehman

Erasmus Research Institute of Management – ERIM
The joint research institute of the Rotterdam School of Management (RSM)
and the Erasmus School of Economics (ESE) at the Erasmus University Rotterdam
Internet: www.erim.eur.nl

ERIM Electronic Series Portal: repub.eur.nl/

ERIM PhD Series in Research in Management, 483
ERIM reference number: EPS-2019-483-S&E
ISBN 978-90-5892-553-4

Design: PanArt, www.panart.nl

This publication (cover and interior) is printed by Tuijtel on recycled paper, BalanceSilk®
The ink used is produced from renewable resources and alcohol free fountain solution.
Certifications for the paper and the printing production process: Recycle, EU Ecolabel, FSC®C007225
More info: www.tuijtel.com

FÜR MEINE ELTERN

Ich bin euch unendlich dankbar für die bedingungslose Liebe, die ihr mir geschenkt habt und die Möglichkeiten, die ihr mir gegeben habt, um meinen eigenen Weg zu gehen.

TO MY PARENTS

I am eternally grateful for the unconditional love and the opportunities that you have given me to find my own way.

Table of Contents

List of Tables

List of Figures

CHAPTER

1

Introduction

1.1 Overview and Relevance

Entrepreneurship is a key driver of economic development and growth (Acs & Varga, 2005; Audretsch & Keilbach, 2004; Galindo & Méndez, 2014; Van Stel, Carree, & Thurik, 2005), innovation (Acs & Audretsch, 2005; Ahlin, Drnovšek, & Hisrich, 2014; Baumol, 2002, 2010; Baron & Tang, 2011), and job creation (Decker, Haltiwanger, Jarmin, & Miranda, 2014; Fölster, 2000; Malchow-Møller, Schjerning, & Sørensen, 2011; Wong, Ho, & Autio, 2005). More than that, entrepreneurs create opportunities for new products, services, business models, as well as new markets in their entirety (Park, 2005; Sarasvathy, 2008; Trimi & Berbegal-Mirabent, 2012). Going beyond economic value creation, entrepreneurs are also often forces for social change (Zahra, Rawhouser, Bhawe, Neubaum, & Hayton, 2008) by addressing complex societal problems such as global environmental challenges (Cohen & Winn, 2007; Schaper, 2016) or poverty reduction (Seelos & Mair, 2005).

Due to the number of significant contributions entrepreneurship makes, governments are emphasizing the importance of entrepreneurship within their policy making (Hart, 2003; Lundstrom & Stevenson, 2005). To illustrate this point, take the European Union (EU) as an example. In their Entrepreneurship 2020 Action Plan they declared the "joint action to unleash Europe's entrepreneurial potential, to remove existing obstacles and to revolutionize the culture of entrepreneurship in Europe" (p. 5) to build "the foundations for future growth and competitiveness that will be smart, sustainable and inclusive, and which would address our principal societal challenges" (EU Commission, 2013, p. 3). Furthermore, the Organisation for Economic Co-operation and Development (OECD) offers "analysis and guidance on entrepreneurship policies at the level of countries, regions and social groups" (OECD, 2019). Minniti (2008) concludes that policy makers should actively work on building institutions and establishing an environment that promotes entrepreneurship. This could be achieved through a number of initiatives ranging from financial support and credit offerings (Harrison, Mason, & Girling,

2004; Khoja & Lutafali, 2008; Li, 2002) and institutional adjustments to encourage higher rates of entrepreneurship such as favorable tax regulations (Bruce & Mohsin, 2006; Gentry & Hubbard, 2000), to policies that either stimulate internationalization and lower international trade barriers (De Clercq & Bosma, 2008; Djankov, La Porta, Lopez-de-Silanes, & Shleifer, 2002; Jones, 2007), or promoting local initiatives for entrepreneurship such as incubators, science parks or knowledge clusters (Jacobides, Knudsen, & Augier, 2006; Langley, Pals, & Ortt, 2005; Storey, 2003).

It becomes clear that entrepreneurship is essential not only to leading economies, but also a driver for positive change in the world. Nonetheless, research on entrepreneurship still shows that there are lacunae in our understanding. Most recently, Shepherd, Wenneberg, Suddaby, and Wiklund (2019) summarized in a comprehensive review article the current state of entrepreneurship research and concluded that no unified theory of entrepreneurship exists. Rather, entrepreneurship encompasses a wide range of theories, inspired by established fields such as psychology, economics, sociology, and is trying to explain a number of outcomes and phenomena. The diversity in relevant questions that have been asked and continue to appear, signals the importance of the growing field of entrepreneurship. Shepherd and colleagues (p. 182) conclude that "[a]s social science scholars, we must observe and explain the world around us, and entrepreneurship scholars are changing along with the manifestations of the phenomena they wish to explain." Coherent with the need for research to capture the multifaceted face of entrepreneurship, the studies in this dissertation answer three research questions, which are aimed at studying entrepreneurship and innovation at different levels. Table 1.1 provides a short summary of the dissertation studies.

Level of Analysis	Theory	Related Discipline	Method	Data and Sample
Micro	Effectuation/ causation; business planning	Psychology	Ordinary Least Square (OLS) regression	Survey: 1,453 entrepreneurs
Meso	Institutional theory; institutional work	Organization studies; organizational sociology	Qualitative, multi-source field study	Fieldwork: 75 hours; archival data: 240 presentations, 3,593 slides; interviews: 27 entrepreneurs/regulators
Macro	National systems of innovation	Innovation/ population studies; organizational ecology	Event history modeling	Population: 1,341 products; longitudinal observation: 11 years

Table 1.1 Summary Dissertation Studies

Three different levels of analysis are considered in this dissertation: the micro level, in which the individual entrepreneur and his/her approach to decision making are central; the meso level, where the interactions between different stakeholders embedded in the entrepreneurial ecosystems form new institutions when industries emerge; and the macro level, which focuses on the whole population of innovative firms and their market outputs. Doing so is an attempt to capture the many facets of entrepreneurship. Various level of analyses require different approaches, concepts, and methods to study the research question ask at each level.

To start with, as outlined before, the multi-faceted, multi-level nature that is characteristic for entrepreneurship demands an approach that is inclusive of multiple disciplines acting in concert to understand the phenomenon to the fullest. Second, these level of analysis enact and demand different conceptual structures. While the focus lies on cognition and heuristics at the micro level, market and non-market strategic decision making comes into play at the meso level. At the macro level, institutions and other social structures such as national innovation systems are

concepts of interest. Eventually, adopting different approaches and concepts to the study of entrepreneurship also requires multiple methods to chart the terrain completely. At the micro level, psychological investigations into entrepreneurial decision making require individuals' subjective assessment, while more sociological accounts of ongoing interactions between stakeholders and emerging institutional structures ask for qualitative, processual methods to be employed. Estimating the importance of certain institutions for global innovation systems, in turn, can best be investigated by drawing from quantitative data analysis to arrive at valid conclusions.

Thus, by thoroughly investigating entrepreneurship and innovation at different level of analysis, including various meaningful concepts and by employing distinct methods, I am able to arrive at relevant conclusions that have an impact on individual entrepreneurs (micro), entrepreneur-stakeholder interactions (meso), as well as national innovation systems (macro). Whether in this dissertation or in future research, existing opportunities reside across levels of analysis, through which numerous approaches, concepts, and methods of entrepreneurship and innovation get to interact.

1.2 Three Levels of Analysis in Entrepreneurship Research and Research Questions

To start with, I focus on the micro level and consider entrepreneurs' decision-making logic and their impact on venture performance. Entrepreneurs can pursue different strategies to deal with the challenges that arise when starting a new venture (Frese, Geiger, & Dost, 2019; Mansoori & Lackéus, 2019; Tryba & Fletcher, 2019). Traditionally, entrepreneurs were believed to be following a logic of strategic business planning, referred to as causation (Sarasvathy, 2001). This decision-making logic emphasizes the prediction of an uncertain future (Ansoff, 1979; Mintzberg, 1978), using competitive analysis as a prediction tool (Porter, 1980),

focusing on profit maximization (Alvarez & Barney, 2007; Friedman, 1953), trying to avoid surprises (Ansoff, 1980; Dutton & Ottensmeyer, 1987) as well as employing goal setting and closely monitoring their achievement (Bird, 1989; Bourgeois, 1985). However, entrepreneurs can make use of a non-prediction-oriented decision-making framework to guide their subsequent actions that is referred to as effectuation (Sarasvathy, 2001). This decision-making logic describes a more adaptive and emergent way of dealing with uncertain environments. Entrepreneurs who apply effectuation principles make use of resources at their disposal to create something new; they calculate according to what they can afford to lose instead of what they think they can gain; they aspire to enter into partnerships and they let plans evolve along the way, inspired by new events and occurrences (Sarasvathy, 2008). Yet, a detailed systematic empirical analysis linking the decision-making logics entrepreneurs employ to firm performance, in which causation and effectuation are carefully conceptualized and operationalized, has thus far not been undertaken. This leads me to formulate the first research question of this dissertation.

Research Question 1: How does an entrepreneurs' decision-making logics influence the performance of his/her venture?

Next, I focus on the meso level and examine dialectical processes involving both entrepreneurs and regulators, in which I capture their attempts to shape a newly arising industry. Contextual factors, such as rules, regulation, and interactions with stakeholders help shape entrepreneurial behaviors and opportunities (Lim, Morse, Mitchell, & Seawright, 2010; Minniti, 2008; Nelson, 2014). This is certainly true in mature industries, in which these practices have become established. Far less evidence exists on how industry-specific factors interact with entrepreneurial behaviors in emerging industries. Intuition suggests it is because rules and practices have not fully become institutionalized in such settings yet (e.g., Ruef & Patterson, 2009; Navis & Glynn, 2010), their grip on entrepreneurs is less tight than in mature

fields. Moreover, entrepreneurs are likely not simply rule followers in emerging contexts, but have a relatively greater influence on processes of rule selection, refinement, reinforcement, and proliferation. Yet, we know very little about the micro-momentary actions of entrepreneurs as they engage with regulatory and normative contexts in emerging fields, nor about the consequences of these actions for proto-institutional emergence. This leads me to formulate the second research question of this dissertation.

Research Question 2: How do regulatory proto-institutions arise in technological innovation-intensive and behavioral change-prone organizational fields?

Finally, I focus on the macro level and investigate institutional drivers of innovation. While it has been established that institutions are necessary to support entrepreneurship and innovation nationally (Acs, Desai & Hessels, 2008; Boettke & Coyne, 2009; Mazzucato, 2013; Spencer & Gómez, 2004), the focus has long been on public and private civil institutions. Although it is essential for a country's innovativeness to have strong university systems, investment communities and R&D clusters, there still seems to be a gap in the institutional matrix (North, 1991) for many countries to produce frame-breaking innovations. Reasons include a lack of complementary assets (Teece, 1998; Tripsas, 1997), short-term focused investment horizons (Bertoni & Tykvová, 2015; Cumming, 2007), underinvestment in fundamental and precompetitive research (Feller, Ailes, & Roessner, 2002; Niosi, Saviotti, Bellon, & Crow, 1993), and the absent capacity of translating this research to market-ready products (Carayannis & Alexander, 2004; Woolf, 2008). Thus, with public and private civil institutions exhibiting shortcomings, another institution fostering innovation that has so far largely been overlooked by management researchers offers clarification, namely the military. This leads me to formulate the last research question of this dissertation.

Research Question 3: How can the military support civil innovation institutions to develop market-ready products?

1.3 Outline Dissertation Studies

In the following three chapters, I will present the three studies that together form the main body of my dissertation. They answer the research questions that are presented above. Next, I outline these three dissertation studies briefly.

1.3.1 Abstract Study 1: Get it Together! Synergistic Effects of Causal and Effectual Decision-Making Logics on Venture Performance

Entrepreneurs rely on different decision-making logics when starting new ventures, including causal and effectual reasoning. Literature states that both logics have their merits and different mechanisms are at work that can positively influence firm performance, but studies have not yet tested the synergistic potential of these two logics. In the first study in this dissertation, I propose that effectuation and causation are two decision-making logics that can be beneficial to venture performance when used in conjunction. This study's results confirm this, but also show that the combined effect of effectuation and causation on firm performance is stronger than their individual effect. To arrive at these conclusions, I utilized survey data from almost 1,500 entrepreneurs residing in 25 countries. This study forms an important contribution to business planning literature and effectuation literature, as both streams of research seem to position themselves as opposites rather than compliments. However, I find that ventures benefit most from using these two entrepreneurial logics – planning-focused causation and action-oriented effectuation – in tandem.

1.3.2 Abstract Study 2: Proto-Institutional Emergence in Technology-Driven Contexts: Dialectic institutional Work in the Dutch Drone Industry

In technological innovation-intensive fields, the regulatory institutional structures that give rise to novel entrepreneurial opportunities while constraining other facets of entrepreneurial behavior are in constant flux. Previous studies have framed the

challenges facing entrepreneurs in mature organizational fields as avoiding the power of overbearing regulators long enough to establish the legitimacy of their ventures. However, in technological innovation-intensive fields, regulatory frameworks for evaluating new ventures are often still lacking, and regulators may choose to actively reach out to entrepreneurs to arrive at a better understanding of the radical technological change and high-frequency changes in entrepreneurial behavior that occur in these settings. To grasp how entrepreneurial opportunities and constraints come about in these settings, I conducted a qualitative processual study of the emergence of the Dutch remotely piloted aircraft systems (colloquially known as "drones") industry between 2000 and 2018. I draw on qualitative data comprising 75 hours of fieldwork, archival data of more than 3,500 slides from 240 presentations as well as 27 in-depth interviews. This study's findings show that regulatory proto-institutions in nascent industries tend to result from *dialectic institutional work* in the form of structured interactions between entrepreneurs and regulators. Specifically, I present a process model that reveals how new regulatory structures evolve in contexts where high levels of technological and behavioral change induce systemic uncertainty and enlarge the interdependence between entrepreneurs and regulators. I suggest that our process theory of proto-institutional emergence generalizes towards other technological innovation-intensive fields. Theoretically, these findings speak to the literatures on institutional work and proto-institutional emergence.

1.3.3 Abstract Study 3: Leviathan In A Lab Coat: How Military Initiatives Help Civil Innovation Institutions Produce Market-Ready Products

Innovation needs institutions to flourish. Traditionally, the focus has been either on public institutions, such as state governments, or on private institutions that specifically aim at stimulating civil innovation, such as Research and Development (R&D) clusters. However, research has shown that public and private institutions in the civil domain are not always capable of producing frame-braking innovation due

to a lack of complementary assets, short-term investment horizons, underinvestment in fundamental research, or limited 'translational' capacity for making fundamental innovations market-ready. I posit that there is another institution essential for innovation, which has been largely overlooked by management researchers but is able to compensate for prevalent institutional shortcomings: the military. I hypothesize that the military fosters innovation by facilitating military-driven technological and human capital spillovers, investing in high-risk innovation projects, as well as building capabilities and adjacent institutions (e.g., infrastructure). I test these hypotheses in the context of the global drone industry using data from 2006 to 2016. Drones have historically been used in military but nowadays are used for a great number of applications in many commercial industries. The sample consists of 1,341 civil drone systems that were created for commercial purposes by 473 producers in 52 countries. Survival analysis was employed to test the influence of military drone presence, military expenditure, and arms import on civil drone market-readiness. The results reveal that the military, as a previously overlooked institution, plays an integral role in civil innovation around the globe. Thus, although some public and private civil institutions help bring innovation to the market, the military is an even stronger driver for a country's innovative strength in the civil sector. This study contributes to literature on institutions for innovation and the institutions-based view, and aims to inform policy makers' decision-making in fostering innovation.

The three studies are summarized in Figure 1.1 to give an overview of the chapters included in the dissertation, the main topics and the level of analyses.

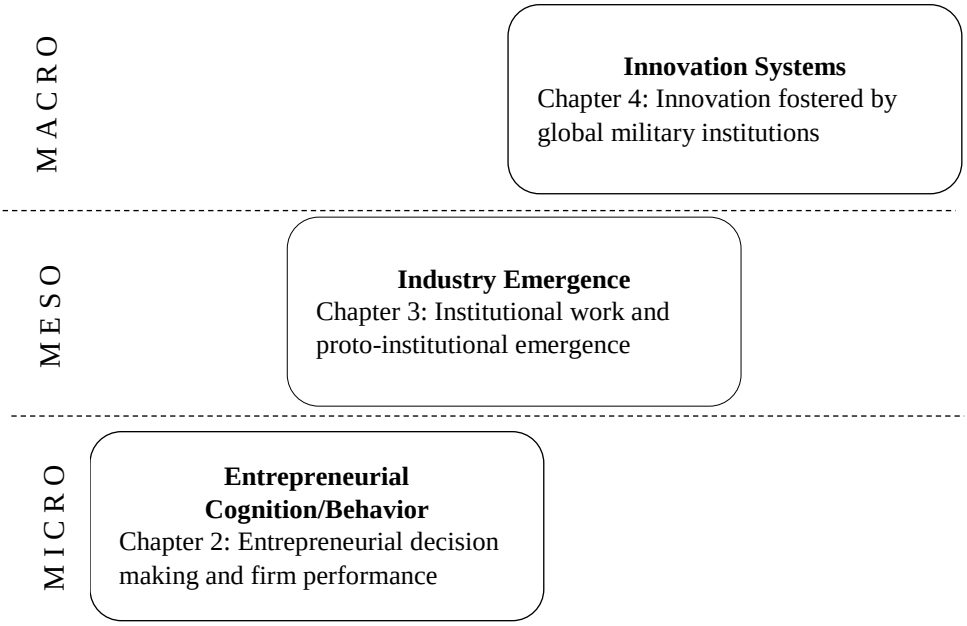

Figure 1.1 Overview Dissertation Studies

1.4 Key Takeaways

In conclusion, there are five key takeaways that can be gained from considering the three studies included in this dissertation:

1) Chapter 2 shows that it is not only vital for venture success that entrepreneurs are able to draw from different decision making logics, but to combine a causation-focused planning approach with a effectuation-driven action approach for achieving the best venture outcomes. This is important for literature on entrepreneurial decision making (Frese et al., 2019; Hauser, Eggers, & Güldenberg, 2019; Laskovaia, Marino, Shirokova, & Wales, 2018; McKelvie, Chandler, DeTienne & Johansson, 2019; Tryba & Fletcher, 2019).
2) Chapter 3 suggests that especially in newly emerging contexts, entrepreneurs are not acting in isolation. On their way towards building institutions, entrepreneurs engage in dialectic institutional work with regulators in an

interactive way, without either of them leading the process. This is important for literature on institutional work and emerging institutions (Lawrence & Suddaby, 2006; Lawrence, Suddaby, & Leca, 2009, 2011; Ozcan & Gurses, 2018; Zietsma & McKnight, 2009).

3) Chapter 2 and Chapter 3 offer important insights on entrepreneurial reasoning and action. While the logic that entrepreneurs employ have an impact on their venture's success in rather mature industries, entrepreneurs engaging with regulators in emerging fields form the future context in which they (as well as coming generations of entrepreneurs) will need to act when rules and regulations have become institutionalized. This is important for literature on institutional entrepreneurship (Bruton, Ahlstrom, & Li, 2010; Lim et al., 2010; Maguire, Hardy, & Lawrence, 2004; Watson, 2013).
4) Chapter 4 concludes that in terms of bringing innovation to the market, a country should not only rely on public and private civil institutions, but also consider the military as it forms a strong driver for national innovative strength in the civil sector. This is important for literature on the intersection between military and civil innovation (Hiatt, Carlos, & Sine, 2018; Honig, Lerner, & Raban, 2006; Koch-Bayram & Wernicke, 2018; Mazzucato, 2013; Ruttan, 2006).
5) Chapter 3 and Chapter 4 both focus on the drone industry and highlight the importance of institutions for entrepreneurship and innovation. Institutions play a vital role for entrepreneurs, even in situations where those very institutions still need to be build. On the other hand, some institutions with a long standing may have been overlooked in the past although their relevance for a country's innovative capacity are indisputable. This is important for literature on institutions in entrepreneurship and innovation (Acs, Autio, & Szerb, 2014; Bradley & Klein, 2016; Filippetti & Archibugi, 2011; Henrekson & Sanandaji, 2011).

1.5 Declaration of Contribution

I declare my contribution to each of the chapters in this dissertation and acknowledge the contributions of other scholars that were involved.

Chapter 1: This chapter was solely prepared by myself and complemented with feedback from my doctoral dissertation supervisor Pursey Heugens.

Chapter 2: I was leading this project as it was my responsibility to carry out a thorough literature review, ground the hypotheses in existing theory, analyze the data, and draft the first version of the paper. I received feedback from my co-authors, subsequently submitted the manuscript, and dealt with revisions necessary towards publication. I also presented previous versions of the study at several academic conferences. This study was published in *Entrepreneurship Theory & Practice* in 2018 with me being the first author, Ingrid Verheul as second author, Katrin Burmeister-Lamp as third author and my doctoral dissertation advisor Pursey Heugens as fourth author.

Chapter 3: I carried out the majority of the work as it was my role in the project to outline the theory on which the research question was built, collect the data through fieldwork, interviews and archival search, analyze the data, as well as draft the paper, all supported with guiding comments from my doctoral dissertation advisor. I also presented previous versions of the study at several academic conferences. By the time the doctoral thesis was submitted, this study was under review at a leading management journal with me being the first author and my doctoral dissertation advisor Pursey Heugens as second author.

Chapter 4: I was responsible for constructing and cleaning the database that the study relied on. I reviewed the literature on this topic, carried out the analyses, and drafted the paper, all supported with guiding comments from my doctoral dissertation advisor. By the time of submission of this dissertation, this study was being prepared for submission to a leading management journal with me being the first author and my doctoral dissertation advisor Pursey Heugens as second author.

CHAPTER

2

Get It Together! Synergistic Effects of Causal and Effectual Decision-Making Logics on Venture Performance

This chapter is based on Smolka, K.M., Verheul, I., Burmeister-Lamp, K., & Heugens, P.P.M.A.R. (2018). Get It Together! Synergistic Effects of Causal and Effectual Decision-Making Logics on Venture Performance. *Entrepreneurship Theory and Practice 42*, 571-604.

2.1 Introduction

To cope with the uncertainties associated with new venture creation, entrepreneurs can opt for different strategies. Planning and action have long been considered two fundamental, yet often contradictory, approaches in managing organizations. Mintzberg and Westley (2001), for example, distinguished between a rational ("think first") and an action-oriented ("act first") approach to decision making[1]. Nevertheless, there has been quite some debate about the relative value of planning and action for successful entrepreneurship. In their recent meta-analysis, Brinckmann, Grichnik and Kapsa (2010) summarize the vivid debate about the importance of business planning for entrepreneurial performance. Alternatively, emphasizing the action element in entrepreneurship, different scholars have explored the importance of improvisation strategies for venture performance (Baker, Miner & Eesley, 2003; Hmieleski & Corbett, 2008). In a similar vein, Sarasvathy (2001) proposes that the future cannot be predicted by writing plans, and that experienced entrepreneurs therefore adopt an effectual (rather than a causal) approach, attempting to control the future by taking action. Finally, new pedagogical models emphasizing experiential learning are steadily replacing conventional planning-oriented methods of teaching entrepreneurship (Honig, 2004; Neck & Greene, 2011), and the question arises whether the combined pursuit of planning and action-oriented approaches may help aspiring entrepreneurs establish long-living ventures in the market.

Empirically, research linking planning and action to venture performance has yielded inconsistent results. First, meta-analytic evidence suggests that the frequently tested relationship between planning and performance is in fact highly contingent upon endogenous and exogenous factors (see Brinckmann et al., 2010). Second, while several scholars have linked the action-oriented effectuation approach to increased venture performance (see Perry, Chandler & Markova, 2012),

[1] In addition to a third intuitive ("seeing first") approach.

this finding deserves further empirical scrutiny. Building on the foundational work of Sarasvathy (2001, 2008), entrepreneurship scholars have studied the role of effectuation in a variety of contexts, including the Swedish mobile internet industry (Berglund, 2007), Norwegian tourism firms (Alsos & Clausen, 2014), Twitter users (Fischer & Reuber, 2011), and UK home-based online businesses (Daniel, Di Domenico & Sharma, 2014). Although the number of quantitative studies exploring the nature, antecedents, and consequences of employing an effectual strategy has grown in recent years (e.g., Appelhoff, Mauer, Collewaert & Brettel, 2016; Dew, Read, Sarasvathy & Wiltbank, 2015; Werhahn, Mauer, Flatten & Brettel, 2015), much of the extant empirical literature still relies on qualitative research methods (e.g., Akemu, Whiteman & Kennedy, 2016; Watson, 2013). As the state of effectuation research can no longer be classified as nascent (Perry et al., 2012), more deductive theory-testing studies are needed to explore the web of nomological relationships between effectuation and its antecedents and consequences, and to shed light on its relationship with alternative entrepreneurial approaches.

In the present study, we distinguish between two alternative decision-making logics for explaining venture performance: that is, predictive (causal) and controlling (effectual) logics. Whereas in practice entrepreneurs frequently use effectuation and causation in tandem (Sarasvathy, 2001, 2003), theory development and empirical evidence concerning potentially synergistic effects between these two approaches is currently still at an early stage. In addition to discussing the conceptual interrelations between effectual and causal decision making, and their linkages with performance, we therefore empirically examine their main and interactive effects on venture performance. Assuming that the interplay between the two logics is synergistic, we propose that entrepreneurs' combined use of effectuation and causation will have a greater impact on venture performance than the sum of their two main (i.e., independent) effects. To test whether the adoption of effectuation and causation is conducive to venture performance (Berends, Jelinek,

Reymen & Stultiëns, 2014; Chandler, DeTienne, McKelvie & Mumford, 2011; Perry et al., 2012), we use an international dataset comprising 1,453 student entrepreneurs residing in 25 different countries.

We aspire to make three contributions with this paper. First, following the call by Perry et al. (2012) to clarify the relationship between effectuation and alternative entrepreneurial approaches, we aim to assess the relationship between effectuation and causation (generally regarded as the dominant alternative logic) both conceptually and empirically. Effectuation scholars have been criticized for incomplete theory building (Arend, Sarooghi & Burkemper, 2015, 2016), and there is a vivid, continued debate concerning the future development of the effectuation literature (Garud & Gehman, 2016; Gupta, Chiles & McMullen, 2016; Read, Sarasvathy, Dew & Wiltbank, 2016; Reuber, Fischer & Coviello, 2016). Further research contributing to the advancement of effectuation as a theory of entrepreneurship is therefore warranted.

Second, by measuring causation and effectuation independently (Wiltbank, Dew, Read & Sarasvathy, 2006), and testing for their main and interactive effects on venture performance, we are able to determine how the two logics contribute to explaining entrepreneurial outcomes. Several researchers have started to investigate the interplay between the two logics (e.g., Alsos & Clausen, 2014; Evald & Senderovitz, 2013; Maine, Soh & Dos Santos, 2015; Nummela, Saarenketo, Jokela & Loane, 2014; Reymen et al., 2015; Sitoh, Pan & Yu, 2014), but empirical evidence of their interactive effects on venture performance is still lacking. As Read et al. (2016, p. 531) highlight: "[e]ffectuation research needs to spell out in more detail […] useful ways to mix and match predictive and non-predictive strategies […]." We thus provide new insights into how causal and effectual logics interact and supply "evidence of relationships between effectuation and […] business planning" (Perry et al., 2012, p. 855). Our findings not only show that causation and effectuation both have positive main effects on venture performance, but also that

their combined use further enhances positive venture outcomes. In particular, entrepreneurs who experiment with available means while also engaging in planning activities tend to realize significantly better venture performance.

Third, we move the effectuation literature forward by developing a concise agenda for future quantitative research in this tradition, emphasizing the need for better measures (Arend et al., 2015; Perry et al., 2012); for disentangling the nomological web of effectuation's antecedents and consequences (Harms & Schiele, 2012); and for distinguishing the concept from other entrepreneurial approaches like bricolage (Baker & Nelson, 2005), improvisation (Hmieleski & Corbett, 2008), and bootstrapping (Bhide, 1991).

2.2 Theory and Hypotheses

2.2.1 Effectuation and Causation

Effectuation is a decision-making framework that guides entrepreneurial action and behavior (Sarasvathy & Dew, 2008, p. 732). Instead of using planning and prediction-oriented techniques (i.e., causation) to increase the robustness of entrepreneurial ventures to contingencies, the focus lies on the use of control strategies such as exercising flexibility and experimentation to create new products and markets (Sarasvathy, 2001, 2008). As such, effectuation is a more proactive and emergent way of dealing with uncertain environments, applying logical reasoning as a means of exerting control over the environment. In contrast, causation involves the use of logical reasoning as a predictive instrument. Causation comprises elements of strategic planning as it aims at predicting an uncertain future (Ansoff, 1979; Mintzberg, 1978). As a decision-making logic, causation combines a strict goal orientation (Bird, 1989; Bourgeois, 1985) with a focus on profit-maximization (Friedman, 1953), competitive analysis (Porter, 1980), and avoiding surprises (Ansoff, 1980; Dutton & Ottensmeyer, 1987). In contrast, entrepreneurs who apply non-predictive control (effectuation) make use of other principles, which were first

documented by Sarasvathy (2001, 2008) and colleagues (e.g., Read & Sarasvathy, 2005; Sarasvathy & Dew, 2005; Sarasvathy, Dew, Read & Wiltbank, 2008; Wiltbank et al., 2006). These principles include creating something new by starting with available resources (i.e., intellectual, human, and social capital), limiting losses to an affordable level, creating partnerships, and letting plans evolve along the way. The main differences between causal and effectual reasoning are summarized in Table 2.1.

	Causal reasoning	Effectual reasoning
Starting point for reasoning/action	• Goal orientation: which means are needed to accomplish certain goals? • Clearly specified and given goals	• Means orientation: which goals can be achieved with the available resources? • Imagined and evolving goals
Risk predisposition	• Decision making on the basis of financial forecasting • Calculating net present value • Maximizing expected returns • High upfront resource commitments	• Decision-making on the basis of what individuals are able and willing to risk (also non-financials) • Determining affordable loss • Limiting downside risk • Lean business operations
Attitude toward third parties	• Threat of competitors • Careful selection of alliance partners • Relationships are limited to what is considered necessary • Contractual trust: extensive contracting to restrict opportunistic behavior	• Parties can gain by working together • Actively looking for partners • Self-selected stakeholders • Commitment-based trust: partners benefit from making (small) credible commitments to a joint course of action
Environmental contingencies	• Contingencies are undesirable deviations from the plan	• Contingencies offer new opportunities

Sources: Sarasvathy (2001, 2008); Sarasvathy & Venkataraman (2001); Read & Sarasvathy (2005); Sarasvathy & Dew (2008).

Table 2.1 Causal Versus Effectual Reasoning

While early work on effectuation and causation was concerned primarily with describing these two decision-making logics (Sarasvathy 2001; Wiltbank et al., 2006), researchers have more recently started to examine the antecedents and consequences of effectuation (Harms & Schiele, 2012) and to ask questions about the appropriate dependent variable for this stream of research (McKelvie, DeTienne & Chandler, 2013). In the present study, we argue that effectuation and causation are connected to venture outcomes through different pathways.

2.2.2 Causation and Venture Performance

Whereas there are a large number of studies on the virtues of strategic planning in established companies (Miller & Cardinal, 1994; Schwenk & Shrader, 1993), studies focusing explicitly on causation as an entrepreneurial decision-making logic remain scarce. One of the few notable exceptions includes Kristinsson, Candi and Sæmundsson (2016), who explicitly include causation as a moderating decision-making logic in their study investigating the influence of founding team diversity on idea generation and innovation. Likewise, examining R&D performance in a corporate context, Brettel, Mauer, Engelen and Küpper (2012) found that the outcomes of intrapreneurial projects with a low level of innovation were improved when applying causal decision making. Finally, DeTienne, McKelvie and Chandler (2015) examined causation based decision making in the context of entrepreneurial exit strategies, where entrepreneurs used a causal approach to pursue financial harvest exit strategies.

Yet there is also a closely related, and more extensive, literature on the practice-based side of causation, which centers on the use of planning for achieving predetermined goals. In this literature, the value of business planning in relation to venture performance is heavily debated (Burke, Fraser & Greene, 2010; Chwolka & Raith, 2012; Delmar & Shane, 2003; Gruber, 2007; Honig & Samuelsson, 2014). Thus far, the overall evidence points to a positive relationship between planning and

venture performance. In their meta-analysis on this relationship in the context of small and medium-sized enterprises, Mayer-Haug, Read, Brinckmann, Dew and Grichnik (2013) show that planning activities and entrepreneurial planning skills are positively related to the growth, scale, and sales of these firms. Furthermore, Brinckmann et al.'s (2010) meta-analysis demonstrates that both a written business plan and planning as a process are beneficial for new venture performance, although the strength of the relationship depends on contextual factors like firm age and the cultural environment. In the field of strategic management too there is ample evidence that business planning positively influences venture performance in many instances (e.g., Capon, Farley & Hoenig, 1990; Capon, Farley & Hulbert, 1994; Miller & Cardinal, 1994).

Business planning might positively affect venture performance for different reasons. It guides action by setting objectives, the achievement of which is contingent upon pre-determined plans and thorough analyses. Delmar and Shane (2003), for example, see planning as an important precursor to action in new ventures, helping entrepreneurs in the decision-making process and allowing them to take steps toward goal achievement. Furthermore, a written business plan may enhance venture legitimacy, as entrepreneurs are able to use it to convey the feasibility and viability of their business concept to investors. Legitimacy is vital for new ventures, as it increases their chances of surviving the early stages of their life cycles by facilitating entrepreneurial resource acquisition (Delmar & Shane, 2004; Fisher, Kotha & Lahiri, 2016). Investing time and effort in writing a business plan also signals an entrepreneur's commitment to the venture and may enhance learning by carefully thinking through all aspects of the firm; outlining structures and processes (Castrogiovanni, 1996); and collecting information on competitors, industry dynamics, and the marketplace (Frese & Gielnik, 2014). We therefore hypothesize the following:

Hypothesis 1: An entrepreneur's use of causal reasoning is positively related to venture performance.

2.2.3 Effectuation and Venture Performance

A small but impactful range of studies has related effectuation to performance. Based on the outcomes of 28 independent studies, and using proxies to capture adherence to effectuation principles[2], Read, Song and Smit (2009) were among the first to report a positive and significant overall relationship between the use of effectuation and venture performance. In particular, positive links with performance were found for means-orientation, partnerships, and leveraging contingencies, but no significant relationship was found for affordable loss. Following Read et al.'s example, several studies have examined the link between effectuation (versus causation) and performance in different contexts. For example, Wiltbank, Read, Dew and Sarasvathy (2009) found that business angel investors focusing on control (effectuation) rather than on prediction (causation) in their investment portfolios experienced fewer failures without a reduction in the number of successes. Also, Brettel et al. (2012) show that effectuation is positively linked to process output and efficiency in highly innovative R&D projects. Furthermore, Sullivan Mort, Weerawardena and Liesch (2012) found that entrepreneurial marketing approaches relying on effectuation lead to superior performance within born global firms. Finally, in the context of the Chinese transitional economy, Cai, Guo, Rei and Liu (2016) provide additional support for the positive effect of effectuation on new venture performance.

Several scholars found evidence for effectuation as a moderator variable, including Mthanti and Urban (2014), who demonstrate that effectuation strengthens the relationship between entrepreneurial orientation and performance in high-tech

[2] For instance, to measure the effectual principle of partnerships, studies were included that examined outside members of the board, number of alliances, overlap in partners' goals, and reliance on external sources of technology.

firms. Likewise, Deligianni, Voudouris and Lioukas (2015) show that the effectual principles of experimentation, flexibility, and pre-commitments positively moderate the relationship between product diversification and new venture performance. As the available empirical evidence suggests that firms benefit from adopting an effectual approach in different contexts, we subsequently explore the underlying mechanisms that are at play by discussing the potential linkages between the separate principles of effectuation and venture performance.

2.2.3.1 Means-Driven Action

Means-driven action allows entrepreneurs to draw from and experiment with the resources at their disposal, including personal characteristics and traits, background knowledge, networks, and social contacts (Sarasvathy, 2001; Sarasvathy & Venkataraman, 2001), often leading them to make adjustments to their original business idea. When employing effectual reasoning, entrepreneurs first imagine goals that are within their reach given their set of means, and then experiment with these means to find out what goal fits best (Sarasvathy, 2001, 2008). In other words, effectual entrepreneurs experiment with their means to select business opportunities that limit potential losses to an affordable level and attract committed partners. Means-driven entrepreneurs are therefore natural experimenters. As they start by considering all available resources and proceed to experiment creatively in a low-cost manner, we expect the ventures of means-driven entrepreneurs to perform better, as they are able to fluidly and efficiently adapt their business processes to evolving customer needs (Blank, 2013).

2.2.3.2 Affordable Loss

Forecasting potential financial gains can be challenging, as the equation necessarily includes many unknown variables. Moreover, pursuing future returns requires high upfront resource commitments, making it difficult to keep operations lean and driving up the cost of potential early failure. While causation-oriented entrepreneurs frequently use approaches such as estimating net-present values to determine the

feasibility of their start-up (Campbell, 1992), effectual entrepreneurs turn this process around. Focusing on their affordable loss, defined as the amount of available resources they are willing and able to lose in the start-up process, they limit their downside risk (Sarasvathy, 2001, 2008). In addition to monetary resources, the resources under consideration may include time, personal relationships, reputation, and even health. Effectual-oriented entrepreneurs also form partnerships enabling them to find low-cost ways of reaching their customers, while remaining open to adjusting their course of action (Sarasvathy, 2008, p. 88). Operating with a focus on affordable loss may therefore improve venture performance (Dew, Read, Sarasvathy & Wiltbank, 2009). Specifically, entrepreneurs can improve venture performance when they put an upper bound on losses, thus limiting costs and increasing efficiency.

2.2.3.3 Partnerships

To fully exploit the means available to them, effectual entrepreneurs seek to create win-win situations in which intrinsically motivated outsiders voluntarily commit their resources to jointly build a successful firm (Sarasvathy, 2001, 2008). Such stakeholders are self-selected, commit to the extent that they want to contribute to the new venture, and may include people (e.g., customers, suppliers, technology enthusiasts) or organizations (e.g., financial institutions, universities; Sarasvathy, 2008). In working with partners who are willing to help shape future outcomes, uncertainty is reduced, as there is the opportunity for risk sharing (Eisenhardt & Schoonhoven, 1996). Effectual partnerships are built on the assumption that, in uncertain environments, "the only way for each party in the relationship to benefit is by making small (affordable-loss based) but credible commitments to a joint course of action even if each is unsure of the other's trustworthiness down the road" (Sarasvathy & Dew, 2008, p. 728). Without a pre-determined goal to achieve, effectual entrepreneurs can draw on valuable resources that would otherwise not have been available (Alvarez & Busenitz, 2001; Barney, 1991). Shaping the

venture's future through combined action may thus lead to better performance (Sarasvathy, 2008).

2.2.3.4 Leveraging Contingencies

By embracing the unexpected, that is, making good use of contingencies that arise when starting a new venture, effectual entrepreneurs remain flexible. Whether these contingencies are unanticipated events, accidental meetings, or the disclosure of new information, surprises are seen as opportunities. Unforeseen occurrences that may seem disadvantageous at first can be transformed to produce favorable outcomes (Sarasvathy, 2008). The ability to leverage contingencies can benefit effectual entrepreneurs who see unexpected events as (potential) new resources. Whereas positive surprises naturally work to an entrepreneur's advantage, negative surprises can also be leveraged if the entrepreneur can adapt to the new circumstances faster or better than competitors (Harmeling, 2011). Read, Sarasvathy, Dew, Wiltbank and Ohlsson (2011, p. 144) refer to the "contingency path of novel outcomes", implying that entrepreneurs who embrace contingencies may experience better venture performance. This adaptive behavior can be particularly advantageous when other companies are less flexible because they stick to their business plans more rigidly, and are therefore less able to learn or benefit from unforeseen incidents (Nadkarni & Narayanan, 2007; Worren, Moore & Cardona, 2002). We therefore posit the following hypothesis:

> *Hypothesis 2: An entrepreneur's use of effectual reasoning is positively related to venture performance.*

2.2.4 Synergistic Effects of Effectuation and Causation

While some researchers see effectuation and causation as opposite ends of a dichotomized construct (Brettel et al., 2012), others stress that they should not be seen as two sides of a continuum (Perry et al., 2012). We follow the latter research tradition, in which the two logics are not regarded as opposites, but are seen as

orthogonal in nature. Sarasvathy (2001, p. 245) states that "both decision-making logics are integral parts of human reasoning and can occur simultaneously, overlapping and intertwining over different contexts of decisions and actions", implying that causation and effectuation should not be seen as opposite poles. Similarly, Sarasvathy (p. 249) noted that "effectuation processes are not posited here as 'better' or 'more efficient' than causation processes in creating artifacts such as firms". Although neither causation nor effectuation is thus considered a superior approach in the *process* of creating a new firm, performance *outcomes* may vary, depending upon how the two approaches are combined. Indeed, effectuation and causation can be seen as complementary logics, allowing entrepreneurs to cope with different contingencies throughout the life cycle of their ventures. The ability of effectuation processes to contribute to venture performance might therefore well be contingent upon the presence of at least a threshold level of causation processes, and the other way around. Moreover, depending on the level of uncertainty surrounding any given decision that needs to be made, either causation (in case of low uncertainty) or effectuation (in case of high uncertainty) would be preferable in that specific context. New venture founding involves a great number of decisions to be taken, with each decision comprising a different level of contextual uncertainty. We propose that causal reasoning is best used for decisions involving predictable outcomes, whereas effectual reasoning is best applied to unpredictable situations. Saliently, venture performance appears to benefit from the involvement of entrepreneurs who have both decision-making logics in their repertoires.

Although the combined use of effectuation and causation by entrepreneurs has attracted the interest of numerous researchers (e.g., Evald & Senderovitz, 2013; Maine et al., 2015; Nummela et al., 2014; Reymen et al., 2015; Sitoh et al., 2014), to our knowledge studies that empirically test for interactive effects of these two decision frameworks on venture performance are currently absent. Interestingly, Brinckmann et al. (2010) recommend the combined use of a dynamic practice of

planning (causal approach) and doing (effectual approach) for new and established small firms. They suggest that entrepreneurs can enhance their planning activities with the information gained from experience, thus letting plans evolve depending on feedback from the environment. This highlights the temporal aspect in the discussion of the effectuation-causation relationship, demonstrating that planning and execution can take place concurrently, sequentially, or recursively. Examining new product innovation processes in small firms, Berends et al. (2014) show that effectuation is mainly used in the early venture stages, while causation is emphasized in later stages. Although the aforementioned studies acknowledge the feasibility and desirability of employing causal and effectual decision-making logics, they do not empirically examine the implications for venture performance. In the remainder of this paper, we set out to determine how the combined use of causal and effectual logics can be beneficial to venture performance.

Our point of departure is that, within any new venture, specific business functions require different approaches. To the extent that members of the founding team have diverse backgrounds, they may differ in their proclivity toward either causal or effectual decision-making approaches, and problem-solving styles (Nummela et al., 2014). Such diversity may lead to mutual learning outcomes, improved creativity, and more innovativeness, which will benefit the firm (Chandler & Lyon, 2001; Horwitz & Horwitz, 2007; Maznevski, 1994). Timing is also important when considering the joint use of causation and effectuation (Reymen et al., 2015) and their combined contribution to venture performance. When entrepreneurs or entrepreneurial teams are able to switch from one decision logic to the other, depending on the uncertainty level surrounding the decision to be made, thus always selecting the decision making approach that fits the situation best, the new venture is likely to profit.

Business tasks can thus be approached using both logics in tandem (Sitoh et al., 2014). While using a causation-oriented approach to introduce general

structures and action plans, an entrepreneur can concurrently use an effectuation-oriented approach to explore a wider range of options within the broad boundaries set by prior planning efforts (Reymen et al., 2015). This allows the entrepreneur to enjoy the benefits of both approaches. In particular, designing business strategies based on long-term objectives may be combined with short-term experiments, such as making changes to product features (Frese, 2009). While the entrepreneur draws on the currently available means to shape the new venture along the way, the identification of future goals helps determine growth ambitions (Frese et al., 2007). This way, entrepreneurs are able to reap the benefits from both approaches, employing causation and effectuation concurrently to strengthen venture performance.

The same reasoning applies to financial decisions. When entrepreneurs make profitability forecasts to support growth decisions, current resources might only be committed to the process if the entrepreneurs can afford using (and losing) them. By considering upward potential alongside protection from downside loss, entrepreneurs can make better informed and more balanced decisions, which may positively impact venture performance.

Furthermore, the combined use of alliances and partnerships may also have synergistic effects. Effectual entrepreneurs work together with committed stakeholders to shape the future of their ventures, but causal planning mechanisms can provide these entrepreneurs with more focus in the process (Rothaermel & Deeds, 2006). Agreements made with stakeholders reduce uncertainty about the future of the new venture, while at the same time resources and networks can be shared with alliance members (Teng, 2007). As a consequence, venture performance may increase as the pool of new resources and options widens.

Finally, the flexibility that effectual thinking promotes can be combined with the careful weighing of the costs and benefits associated with each option explored in the causal approach. The entrepreneur can take advantage of

opportunities that arise due to unexpected events while still focusing on a long-term goal (Zheng & Mai, 2013). Plans serve as a guideline that can be deviated from, while still providing an underlying structure, when new information creates awareness about and access to new opportunities. Furthermore, activities supporting the planning process, such as developing action plans that are not necessarily transformed into formal documents, may enhance the positive effect of goal setting on venture creation and outcomes (Gielnik & Frese, 2013). Hence, venture performance benefits from the mutually reinforcing effect that flexibility has in some areas and rigidity in others.

In conclusion, using causation and effectuation in tandem can lead to synergies, especially when the benefits of both decision-making logics are combined to strengthen venture performance. Thus, we hypothesize that a strict focus on either causation or effectuation will be less effective than a balanced use of both approaches, as it allows entrepreneurs to optimally cope with a wider range of contingencies when adjusting their decision-making to the level of contextual uncertainty surrounding that decision. Accordingly, we formulate the following hypothesis:

> *Hypothesis 3: An entrepreneur's joint use of causal and effectual reasoning will have a positive interactive effect on venture performance.*

Figure 2.1 summarizes the direct and interactive effects we propose causation and effectuation to have on venture performance.

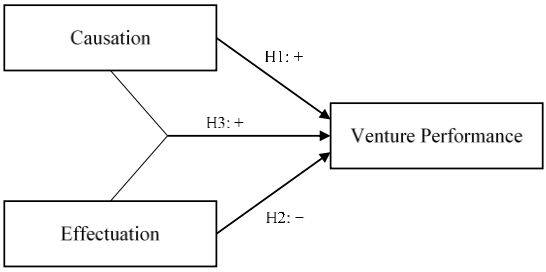

Figure 2.1 Proposed Effects of Causation and Effectuation on Venture Performance

2.3 Methodology

2.3.1 Data and Sample

Our data were collected as part of the Global University Entrepreneurial Spirit Students' Survey (GUESSS), an international research project coordinated by the Swiss Institute for Small Business and Entrepreneurship at the University of St. Gallen. The survey investigates entrepreneurial attitudes, intentions, and activities of students enrolled in institutions of higher education. The project is not limited to students following entrepreneurship programs or classes, and includes students at different education levels (i.e., graduate, undergraduate, doctoral) and from different programs (i.e., business and economics, natural sciences, social sciences). Country coordinators were appointed to contact and "recruit" universities, and participating universities subsequently use their own databases to invite students to participate via an email with a link to the online survey.[3]

We use the international GUESSS data collected between March and May 2011 from 489 universities in 26 countries, resulting in a data base of 93,265 respondents. In most countries, data were collected in two rounds (i.e., initial invitation and reminder), and the survey was translated into the local language. The 2011 GUESSS consists of different parts, including questions all respondents must answer about personal background, university context, career choice intentions and motives, and family background. Specific groups of respondents, that is, intentional founders, active entrepreneurs, and students whose parents have a family business, are subsequently asked to answer additional questions.[4]

Student entrepreneurs were identified with the following question: "Please indicate if, and how seriously, you have been thinking about founding your own

[3] For more background information on the GUESSS project, we would like to refer the reader to the website www.guesssurvey.org.
[4] See Sieger, Fueglistaller, and Zellweger (2011) for more information on the GUESSS outcomes.

company." Answer categories include: (1) Never, (2) Sketchily, (3) Repeatedly, (4) Relatively concrete, (5) I have made an explicit decision to found a company, (6) I have a concrete time plan when to do the different steps for founding, (7) I have already started with the realization, (8) I am already self-employed in a firm I founded myself, and (9) I have already founded more than one company, and am active in at least one of them. Participants answering (8) or (9) are classified as entrepreneurs. Being identified as an entrepreneur, the respondent was then asked questions about the founding process and characteristics and performance of the company. On average, 2.4% of all surveyed students in the different countries were self-employed.

Other researchers have used the GUESSS data for different purposes, for example to study family businesses (Zellweger, Richards, Sieger & Patel, 2016) or career choice intentions (Sieger & Monsen, 2015).

Our sample includes 2,207 student entrepreneurs from 25 countries[5] who run their own venture while following a university education. About a fourth (23.7 %) of our sample consists of entrepreneurs who founded more than one venture in the past and thus can be considered serial entrepreneurs. The final sample, excluding missing data for the dependent, independent, and control variables, consists of 1,453 observations.

The average age of the entrepreneurs in the final sample is 31 years. Roughly two-thirds of the respondents are male (69%). The self-reported median annual sales in 2010 amounted to 12,539 Euro with an average of 447,934 Euro. However, only 26.4% of the respondents managed to generate more than 50,000 Euro in sales. Almost half of our sample did not employ any staff (49.1%), 15.4%

[5] These countries include: Argentina, Austria, Belgium, Brazil, Chile, China, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Liechtenstein, Luxembourg, Mexico, Netherlands, Pakistan, Portugal, Romania, Russia, Singapore, South Africa, Switzerland, and the United Kingdom. Although Japan participated in the study, this country did not report student entrepreneurs.

had one employee, 10.5% had two employees, and the remainder employed three or more people (25%). About one third (35.4%) of the ventures in our sample is younger than 2 years, and roughly another third (29.9%) is between 2 and 5 years old. The remainder (34.7%) are ventures of 5 years and older. Most firms operate in the service industry (51.8%), while agriculture, forestry, and fishing is least common (3%).

2.3.2 Measures

2.3.2.1 Venture Performance

The measurement of the dependent variable was adapted from Eddleston, Kellermanns and Sarathy (2008). Respondents were asked to rate the performance of their business since its establishment in comparison to their competitors on a 7-point Likert scale (1=worse, 4=equal, 7=better). Dess and Robinson (1984) suggest that subjective ratings of company performance are closely related to objective performance measures, and may be used when objective data are not available.[6] We constructed an index of performance by taking an average of the results across three dimensions, namely development of sales, market share, and profit (α = .88).

2.3.2.2 Causation and Effectuation

The measures for the independent variables were adapted from Chandler et al. (2011), who validated causation and effectuation measures with the help of exploratory and confirmatory factor analysis, showing content validity, face validity, predictive validity, and construct validity. We follow the terminology used by Chandler et al., which differs slightly from that originally proposed by Sarasvathy (2001), but relates to a scale that has been validated for collecting survey data. See Table 2.2 for a comparison of terminologies.

[6] In their study, Eddleston et al. (2008) also refer to Love, Priem and Lumpkin (2002) as well as Venkatraman and Ramanujam (1987) who support this claim and conclude that subjective measures and objective measures of performance are strongly correlated.

	As originally conceptualized (Sarasvathy, 2001)		As operationalized for validated scale (Chandler et al., 2011)	
Overall premise	Non-predictive control	*"Effectuation […] focuses on the controllable aspects of an unpredictable future. The logic for using effectuation processes is: To the extent that we can control the future, we do not need to predict it."* (p.252)	---[1]	
Starting point for reasoning/action	Means-driven action	*"Only some means or tools are given; decision-making […] help choose between possible effects that can be created with given means; given specific means, choice of effect is driven by characteristics of the actor and his or her ability to discover and use contingencies."* (p.251)	Experimentation	*"a focus on short-term experiments to identify business opportunities in an unpredictable future"* (p.377)
Risk predisposition	Focus on affordable loss	*"Effectuation predetermines how much loss is affordable and focuses on experimenting with as many strategies as possible with the given limited means. The effectuator prefers options that create more options in the future over those that maximize returns in the present."* (p. 252)	Affordable loss	*"a focus on projects where the loss in a worst-case scenario is affordable"* (p.377)
Attitude towards third parties	Focus on partnerships	*"Effectuation emphasizes strategic alliances and precommitments from stakeholders as a way to reduce and/or eliminate uncertainty and to erect entry barriers."* (p.252)	Pre-commitments	*"an emphasis on pre-commitments and strategic alliances to control an unpredictable future"* (p.377)
Environmental contingencies	Leveraging contingencies	*"Effectuation […] would be better for exploiting contingencies that arose unexpectedly over time."* (p.252)	Flexibility	*"exploitation of environmental contingencies by remaining flexible"* (p.377)

[1] Not operationalized or included in research.

Table 2.2 Overview of Effectuation Principles

Respondents answered a series of questions about how they laid the foundation for their company by rating different founding strategies on a 7-point Likert scale (1=strongly disagree, 7=strongly agree). Our exploratory factor analysis yielded a one-factor solution for the causation items and a four-factor solution for the effectuation items. These latter four factors corresponded to the effectuation dimensions of experimentation, affordable loss, pre-commitment, and flexibility (see Table 2.3). We constructed the scale variables by calculating average scores for the items representing the underlying dimensions. Cronbach's alpha was used to assess the internal consistency of the scales. Nunnally (1978) proposes a value of at least 0.7 for a reliable scale, a requirement that is satisfied in our study. The unidimensional construct of causation was measured using a 5-item scale (α = .90). Effectuation was measured along its four dimensions: using a 3-item scale for experimentation (α = .76)[7], a 3-item scale for affordable loss (α = .87), a 2-item scale for pre-commitment (α = .79) and a 4-item scale for flexibility (α = .76; see Table 2.4). We also constructed an aggregated effectuation measure that included all items (α = .88).

[7] It should be noted that one item from the GUESSS database has been deleted, namely a reverse-phrased question for the inverse of the item asking whether the product/service provided is essentially the same as originally conceptualized. Even after recoding the item to match the direction of the other questions in the scale, it turned out to be problematic (α = .66). As this item is tautological and does not add value to the scale, it was removed.

	Factor				
	1	2	3	4	5
	Causation	Affordable Loss	Flexibility	Experimentation	Pre-commitments
I analyzed long run opportunities and selected what I thought would provide the best returns.	.751				
I designed and planned business strategies.	.845				
I organized and implemented control processes to make sure we meet objectives.	.805				
I researched and selected target markets and did meaningful competitive analysis.	.820				
I designed and planned production and marketing efforts.	.790				
I experimented with different products and/or business models.				.626	
The product/service that I now provide is substantially different than I first imagined.				.825	
I tried a number of different approaches until I found a business model that worked.				.816	
I was careful not to commit more resources than I could afford to lose.		.843			
I was careful not to risk more money than I was willing to lose with my initial idea.		.902			
I was careful not to risk so much money that the company would be in real trouble financially if things did not work out.		.826			
I allowed the business to evolve as opportunities emerged.			.788		
I adapted what I was doing to the resources we had.			.700		
I was flexible and took advantage of opportunities as they arose.			.819		
I avoided courses of action that restricted our flexibility and adaptability.			.509		
I used a substantial number of agreements with customers, suppliers and other organizations and people to reduce the amount of uncertainty.					.792
I used pre-commitments from customers and suppliers as often as possible.					.848

Note: Principal component analysis, varimax rotation with Kaiser normalization and 5 factors.

Table 2.3 Factor Analysis Results

Causation	I analysed long run opportunities and selected what I thought would provide the best returns. I designed and planned business strategies. I organized and implemented control processes to make sure we meet objectives. I researched and selected target markets and did meaningful competitive analysis. I designed and planned production and marketing efforts.
Effectuation: Experimentation[1]	I experimented with different products and/or business models. The product/service that I now provide is substantially different than I first imagined. I tried a number of different approaches until I found a business model that worked.
Effectuation: Affordable Loss	I was careful not to commit more resources than I could afford to lose. I was careful not to risk more money than I was willing to lose with my initial idea. I was careful not to risk so much money that the company would be in real trouble financially if things did not work out.
Effectuation: Pre-commitment	I used a substantial number of agreements with customers, suppliers and other organizations and people to reduce the amount of uncertainty. I used pre-commitments from customers and suppliers as often as possible
Effectuation: Flexibility	I allowed the business to evolve as opportunities emerged. I adapted what I was doing to the resources we had. I was flexible and took advantage of opportunities as they arose. I avoided courses of action that restricted our flexibility and adaptability.

[1] Item deleted: The product/service that I now provide is essentially the same as originally conceptualized.

Table 2.4 Causation and Effectuation Scale (adapted from Chandler et al., 2011)

2.3.2.3 Control Variables

We control for several background characteristics of the entrepreneur that are likely to influence venture performance, including the entrepreneur's age, gender, commitment, prior experience, and parental role models. The age of the entrepreneur may capture endowments of human capital, such as work and life

experience (Cowling & Taylor, 2001; Gimeno, Folta, Cooper & Woo, 1997). The literature has furthermore reported gender differences in venture performance, suggesting that female entrepreneurs "underperform" as compared to male entrepreneurs, at least on financial metrics (e.g., Du Rietz & Henrekson, 2000; Fairlie & Robb, 2009). We also control for the degree of commitment, using a measure for the average number of weekly hours spent by the entrepreneur on company-related activities. We do so because we expect that entrepreneurs who put more time and effort into their ventures will experience better venture performance (Meyer, Stanley, Herscovitch & Topolnytsky, 2002).

We account for experience effects by including measures for relevant work experience, entrepreneurial experience, and parental role models. Research has shown that industry-specific knowledge and work experience are important for venture performance (e.g., Lee & Tsang, 2001; Van Praag, 2003). We captured work experience as the total number of years the entrepreneur had worked in related jobs before founding his or her firm. We also included a control variable capturing whether the entrepreneur had founded more than one venture in the past (0=no, 1=yes), thus possessing entrepreneurial experience. In addition, (prospective) entrepreneurs can learn about the "nuts and bolts" of venturing from the example set by entrepreneurial parents. Indeed, prior studies have found that being raised in an entrepreneurial household is positively associated with new venture success (e.g., Duchesneau & Gartner, 1990; Gimeno et al., 1997). We control for parental role modeling effects by including a variable indicating whether or not the student entrepreneur had at least one self-employed parent (0=none, 1=at least one).

In addition to individual-level factors, we include several firm-specific (dummy) variables that are commonly associated with firm outcomes. Firm age was measured as the time passed (in years) since the entrepreneur incurred the first expenses for his/her company. Firm size was measured in term of the firm's current number of FTE employees. We also included dummy variables (0=no, 1=yes) to

control for industry effects. We used the U.S. Standard Industrial Classification (SIC) to group firms as follows: agriculture, forestry and fishing (SIC0); construction and manufacturing (SIC1/2/3); transportation and communications/information technology (SIC4); wholesale and retail trade (SIC5); finance, insurance and real estate (SIC6); and other (SIC9). We used businesses in services (SIC7/8) as our reference category.

Finally, to account for country-level cultural effects, we constructed country clusters based on geographical and cultural proximity (cf. Ronen & Shenkar, 1985). Dummy variables (0=no, 1=yes) were included for Northern Europe (Finland), Western Europe (Belgium, France, Great Britain, Ireland, Netherlands), Eastern Europe (Russia), Southern/Southeast Europe (Greece, Portugal, Romania), Latin America (Argentina, Brazil, Chile, Mexico), Africa (South Africa), and Asia (China, Singapore)[8]. Central Europe (Austria, Estonia, Germany, Hungary, Liechtenstein, Luxembourg, Switzerland) was used as reference category.

2.4 Results

2.4.1 Hypothesis Testing

We tested our hypotheses using hierarchical ordinary least squares estimations. With a variance inflation factor (VIF) not greater than 2 for the explanatory variables, there was no reason to suspect multicollinearity problems. While Neter, Wasserman and Kutner (1990) suggest a cut-off value of 10, we stuck to a more conservative threshold (Belsley, Kuh & Welsch, 1980; O'Brien, 2007). The low to moderate magnitude of the correlations reported in Table 2 also indicates that distortion of our results due to multicollinearity issues is not likely.

The descriptive statistics reported in Table 2.5 show that, on average, respondents reported equal or slightly higher performance as compared to their

[8] Please note that the dummy variable for the independent cultural block (Pakistan), did not include any valid cases for analysis after the pairwise deletion of cases with missing values.

competitors (M = 4.28). Effectuation (M = 4.66) is used more often than causation (M = 4.28). A paired t-test reveals that this difference is statistically significant ($p < .01$). When we regressed venture performance on these two decision logics, however (Table 3, Model II), the effect of causation ($t = 7.10$) turned out to be almost twice as large as the effect of effectuation ($t = 4.10$). We furthermore find a strong positive correlation between effectuation and causation ($r = .58$, $p < .01$). In fact, the causation construct correlates more strongly with effectuation than with any other variable. This is an important precursor to a valid test of hypothesis 3, as it suggests that entrepreneurs indeed frequently use the two decision logics in tandem ($r = .58$; $p < .01$). The two constructs are thus not independent, and certainly not one another's inverse. We will return to this finding in the discussion. For work experience and firm size, the standard deviation is relatively high compared to the mean score. This is because in both cases almost half of the sample reported to have no work experience (44.8 %) and no employees (49.1 %).

Our regression results can be found in Table 2.6. The first model includes only control variables. We added the independent variables causation and effectuation in the second model, the interaction term between effectuation and causation in the third model, and the individual effectuation dimensions (experimentation, affordable loss, pre-commitment, and flexibility) in the fourth model. Finally, the interaction terms between causation and the four effectuation dimensions were added in the fifth and last model.

Variables and scales	Mean	S.D.	1	2	3	3a	3b	3c	3d	4	5	6	7	8	9	10	11
1. Performance	4.28	1.49	(.88)														
2. Causation	4.28	1.65	.362**	(.90)													
3. Effectuation	4.66	1.07	.293**	.578**	(.88)												
3a. Experimentation	3.52	1.69	.245**	.551**	.661**	(.76)											
3b. Affordable loss	5.03	1.69	.091**	.266**	.720**	.204**	(.87)										
3c. Pre-commitment	4.42	1.76	.304**	.482**	.683**	.383**	.274**	(.79)									
3d. Flexibility	5.36	1.14	.222**	.348**	.752**	.228**	.476**	.426**	(.76)								
4. Founder age	30.59	9.12	.026	.007	.015	.017	-.011	.000	.031	-							
5. Gender[a]	0.31	0.46	.004	-.038	-.036	-.088**	.029	-.045*	.005	.039	-						
6. Commitment[b]	31.03	21.31	.249**	.262**	.138**	.187**	-.031	.170**	.097**	.176**	-.078**	-					
7. Self-employed parents[c]	0.42	0.49	.090**	.093**	.061**	.056**	-.001	.072**	.060**	-.250**	.006	.039	-				
8. Work experience[d]	3.88	7.02	.104**	.118**	.085**	.045	.031	.087**	.090**	.502**	-.022	.211**	-.087**	-			
9. Entrepreneurial experience[e]	0.24	0.43	.103**	.121**	.063**	.153**	-.055*	.087**	.019	.106**	-.155**	.107**	.024	.065**	-		
10. Firm age	5.28	5.81	.107**	.010	.039	.108**	-.041	.039	.007	.669**	-.049*	.164**	-.112**	.320**	.175**	-	
11. Firm size[f]	2.92	7.75	.208**	.164**	.072**	.110**	-.044*	.131**	.043	.072**	-.039	.193**	.090**	.072**	.109**	.108**	-

Note: Reliability of the measure in parentheses (Cronbach's alpha).
* p<.05; ** p<.01.
[a] 0=Male, 1=Female; [b] Average hours worked/week; [c] 0=No, 1=At least one; [d] Total years of relevant work experience (assuming 50 weeks with 40 hours/week per year); [e] 0=No, 1=Yes; [f] Current number of FTE

Table 2.5 Descriptive Statistics and Correlation Matrix

	Venture Performance									
	Model I		Model II		Model III		Model IV		Model V	
	Std. coeff.	*t*-value	Std. coeff.	*t*-value	Std. coeff.	*t*-value	Std. coeff.	*t*-value	Std. coeff.	*t*-value
Causation			.226***	7.095	.235***	7.393	.209***	6.463	.237***	7.135
Effectuation			.123***	4.102	.117***	3.898				
Experimentation							.029	1.005	.000	.015
Affordable Loss							-.060*	-2.149	-.062*	-2.218
Pre-commitment							.125***	4.267	.124***	4.227
Flexibility							.103***	3.516	.094**	3.131
Founder Age	-.162***	-4.128	-.118**	-3.152	-.109***	-2.911	-.105***	-2.833	-.098**	-2.637
Gender	.041	1.615	.039	1.606	.033	1.346	.041*	1.676	.033	1.358
Commitment	.130***	4.794	.088***	3.391	.088***	3.393	.086***	3.334	.075**	2.884
Self-employed Parents	.034	1.280	.018	.712	.024	.963	.020	.786	.023	.928
Work Experience	.093**	3.178	.058*	2.063	.057*	2.040	.054**	1.957	.053	1.910
Entrepreneurial Experience	.063*	2.453	.037	1.484	.040	1.621	.032	1.313	.034	1.368
Firm Age	.147***	4.312	.156***	4.784	.149***	4.573	.161***	4.996	.148***	4.553
Firm Size	.144***	5.601	.120***	4.879	.119***	4.868	.106***	4.346	.105***	4.296
Causation x Effectuation					.086***	3.614				
Causation x Experimentation									.079**	2.752
Causation x Affordable Loss									.027	.945
Causation x Pre-commitment									.032	1.067
Causation x Flexibility									-.016	-.498
Country Cluster Dummies & Industry Dummies included										
R^2	.136		.217		.224		.231		.241	
F	10.712***		17.243***		17.208***		16.492***		15.051***	
N	1453		1453		1453		1453		1453	

Note: IVs are mean-centered.

*** Significant at the 0.001-level ($p < .001$); ** Significant at the 0.01-level ($p < .01$); * Significant at the 0.05-level ($p < .05$).

Table 2.6 Results of Hierarchical Regression Analyses

The *F*-tests capturing the overall fit of the regression models to the underlying data are all statistically significant, as is the change in *F*-statistics between models. Our results support hypothesis 1, as causation significantly predicts venture performance (β = .23, p < .001; Model II). Causation remains the strongest predictor, even when the interaction term with the effectuation variable is included (β = .21, p < .001; Model IV). We also find support for hypothesis 2. Effectuation is positively related to venture performance (β = .12, p < .001; Model II). The mechanisms driving this relationship are affordable loss (β = -.06, p < .05; Model IV); pre-commitment (β = .13 p < .001; Model IV) and flexibility (β = .10, p < .001; Model IV). Whereas pre-commitment and flexibility are positively related to venture performance, affordable loss is negatively related to our dependent variable. Contrary to our expectations, we thus find that limiting downward risk hurts rather than helps venture performance. Finally, experimentation is not significantly related to venture performance (β = .03, p > .10; Model IV).

We find support for hypothesis 3, in that effectuation and causation can be seen as mutually reinforcing: the interactive effect of causation and effectuation on venture performance is positive (β = .09, p < .001; Model III & Figure 2.2). Moreover, the finding that the two logics are synergistic in nature (i.e., that the combination of effectuation and causation is stronger than the sum of its parts) is further strengthened by the fact that the sum of the effect sizes of the main effects equals 0.349 (Model II), while the effect sizes of the main effects plus that of the interaction term sum up to 0.438 (Model III).

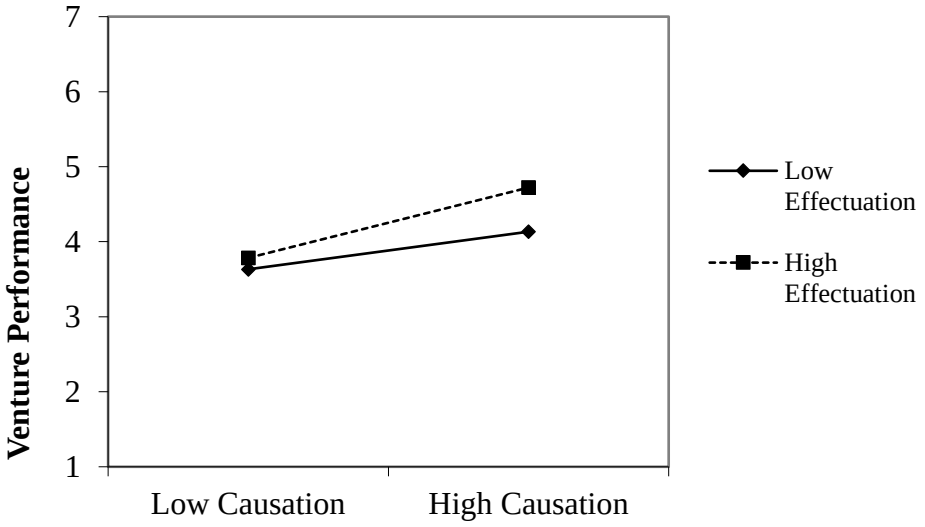

Figure 2.2 Interaction Graph Causation and Effectuation

Next, we examined the four interaction terms between causation and the disaggregated effectuation dimensions to single out the driving mechanisms behind our findings for Hypothesis 3. The combined use of causation and experimentation was positively associated with venture performance (β = .08, p < .01; Model V), while the other interaction terms did not yield statistically significant results (causation x affordable loss: β = .03, p > .05; causation x pre-commitment: β = .03, p > .05; causation x flexibility: β = -.02, p > .05; Model V). We return to these fine-grained findings in the Discussion section. See Table 2.7 for an overview of our hypotheses and a summary of our results.

Hypothesis	Proposed relationship	Degree of support
1	An entrepreneur's use of causal reasoning is positively related to venture performance.	Fully confirmed.
2	An entrepreneur's use of effectual reasoning is positively related to venture performance.	Fully confirmed.

3	An entrepreneur's joint use of causal and effectual reasoning will have a positive effect on venture performance.	Fully confirmed; however, for the separate principles, only causation in conjunction with experimentation has a positive effect on venture performance.

Table 2.7 Summary of Results

2.4.2 Control Variables and Additional Analyses

For our control variables (Model I), we found a negative relationship between the entrepreneur's age and venture performance (β = -.16, p < .001), indicating that younger entrepreneurs are more likely to have better performing firms. An entrepreneur's commitment to the venture is positively related to performance (β = .13, p < .001). Founders who spend more time on their new businesses thus appear to harvest the fruits of their labor. Similarly, previous work experience (β = .09, p < .01) and entrepreneurial experience (i.e., having founded a venture before; β = .06, p < .05) are both positively associated with venture performance. Finally, firm age (β = .15, p < .001) as well as firm size (β = .14, p < .001) are positively related to performance. Being female (β = .04, p > .05) and having self-employed parents (β = .03, p > .05) are not significantly related to performance.

To further corroborate our hypothesized results, we categorized our respondents into three groups, based on their relative scores on the effectuation and causation scales. Using the arithmetic mean of their scores on the 7-point Likert items underlying both scales, we defined the group "mainly effectual" entrepreneurs as those individuals who scored at least one and a half points higher on the effectuation than on the causation variable. Similarly, we defined the group of "mainly causal" entrepreneurs as those respondents who scored at least one and a half points higher on the causation than on the effectuation variable. The remaining individuals were assigned to the group of "balanced use" entrepreneurs by virtue of them reporting causation and effectuation scores that were less than one and a half points apart. For this analysis, due to less sample attrition, we had 1,999 responses

available. The majority of our respondents were in the "balanced use" category, namely 73.5%. The "mainly causal" category comprised 6.8% of the sample, while the "mainly effectual" category captured the remaining 19.7%. In a separate regression analysis in which we used the "balanced use" variable as our reference category, the ventures of the entrepreneurs in the "mainly effectual" category significantly underperformed the benchmark (β = -.12, p < .001), whereas the "mainly causal" entrepreneurs were on par with it (β = .01, p > .05). Thus, entrepreneurs who regularly use effectual decision-making might be able to improve the performance of their ventures by increasing the degree in which they also use causal reasoning.

For reasons of brevity and readability, we chose not to include the results for our industry dummy variables and country cluster variables in Table 2.6. Both sets of variables furthermore yielded few significant results. The only industry dummy yielding a significant positive relationship with performance is SIC 6: finance, insurance and real estate (β = .07, p < .05). The two country clusters showing a positive and significant association with performance are Latin America (β = .13, p < .001) and Southern/Southeast Europe (β = .06, p < .05), whereas observations from the Northern European cluster were underperforming the reference category (β = -.06, p < .05). We conclude that there are no major venture performance differences across the industries and regions represented in our data.

In our study, we relied on self-reported data for several reasons. First, obtaining independent and dependent variables from different sources was not possible, due to the international scope of the research. Second, our theoretical interest lies in entrepreneurial decision-making logics, data on which have to be obtained from research participants directly. Third, objective performance data were unavailable for most of the firms in our sample, as young and small ventures are typically not required to publically report their financials. Due to this reliance on

self-reported data, we had to take steps to minimize the potential impact of common method bias.

In detecting and diagnosing the effects of common method variance, we followed procedures recently used by other authors whose work was published in *Entrepreneurship Theory and Practice* (e.g., Lanivich, 2015; Patel & Conklin, 2012; Stevens, Moray & Bruneel, 2015). First, we believe that participants were unable to logically connect independent and dependent variables through a complex research design such as the interaction effects investigated in our study (Brockner, Siegel, Daly, Tyler & Martin, 1997; Chang, Van Witteloostuijn & Eden, 2010; Slater & Atuahene-Gima, 2004). Second, the recommendations by Podsakoff, MacKenzie, Lee and Podsakoff (2003) on procedural techniques for controlling for common method bias were carefully applied within the context of the GUESSS project. The international coordinating GUESSS team clearly communicated guidelines to be followed with regard to the protection of respondents' anonymity, and a standardized invitation was sent out to the country coordinators and participating universities including a notification ensuring that all answers would be treated confidentially. In addition, entrepreneurs filled out the questionnaire online, and were not in direct contact with the researchers. Therefore, any socially desirable answers that could be inferred from the study context or the researchers themselves through personal contact were eliminated.

We tested for common method variance after the data were collected, although statistical *post hoc* analyses and controls for common method bias should be treated with caution (Conway & Lance, 2010). We used Harman's (1967) single-factor test and performed an unrotated principal component factor analysis. Problems with common method variance are likely to be present when one single factor can be detected or when the majority of covariance can be explained by one factor (e.g., Podsakoff & Organ, 1986). The results of our analysis revealed several factors with an eigenvalue greater than 1, with the largest factor accounting for only

33.15% of the total variance. Although no single factor was found and while the largest factor did not account for the majority of the total variance, it is still possible for common method bias to be present. Hence, as Conway and Lance recommended, we also assessed construct validity to uncover the presence of method effects. As the maximum shared variance (MSV) was smaller than the average shared variance (ASV), our constructs all possessed discriminant validity. Also, the ASV was smaller than the average variance extracted (AVE) and the square root of the AVE was greater than the inter-construct correlations (Hair, Black, Babin & Anderson, 2010). There may not be convergent validity if the AVE is less than 0.5, which was the case for experimentation (AVE = 0.44), pre-commitment (AVE = 0.49), and flexibility (AVE = 0.44). However, these values are too close to the proposed threshold to be of major concern. In conclusion, we are confident that, given the outcome of our procedural precaution and statistical tests, common method bias should not be a major concern when interpreting our results.

2.5 Discussion

2.5.1 Implications

2.5.1.1 Assessing the Relationship Between Effectuation and Causation

An important first contribution of our study involves the exploration of the conceptual and empirical interrelationships between effectuation and causation. Acknowledging that the effectual approach is not inherently superior to causation, we responded to Sarasvathy's (2001, p. 249) call to investigate the circumstances under which the use of effectuation and/or causation are conducive to venture performance. We found that effectuation is positively related to venture performance, in particular when the entrepreneur applies the effectual principles of pre-commitment and flexibility. While it seems intuitive that venture performance depends on the extent to which entrepreneurs are flexible, proactively pursue new opportunities, and adapt their businesses to a changing business environment, our

findings emphasize the importance of securing pre-commitments from third parties. It is vital for entrepreneurs to obtain commitments to their new venture from self-selected stakeholders.

To better understand the mechanisms behind the relationship between performance and the creation of pre-commitments, we draw on the notion of the skilled social actor put forward by Fligstein (1997, 2001). Skilled social actors are individuals who cooperate with others by relating to them on an empathetic level, enabling them to bring forward compelling reasons for continued cooperation. Working with stakeholders who self-commit to the new venture, the perspective of the skilled social actor is highly relevant to understand the essence of effectual entrepreneurship. In line with the concept of effectual entrepreneurship, Fligstein (2001, p. 113) argues that skilled actors of the effectual kind "do not have individual fixed interests but instead focus on the evolving collective ends. They keep their goals somewhat open ended, and they are prepared to take what the system will give." Effectual entrepreneurs who successfully engage with others and succeed in securing pre-commitments may be regarded as having highly developed social skills. Whether the pre-commitments are from suppliers investing in the co-creation of the product or from customers engaged in promoting it, their ventures profit from this cooperation. In our study, we demonstrate that ventures relying on stakeholder pre-commitments perform better. In the future, additional research is needed to create a deeper understanding of the behavior of skilled social actors and of the role they play in the partnership principle of effectuation. For practitioners, our findings show that focusing on co-creation with stakeholders remains an essential part of their daily business operations. Not only should entrepreneurs look out for partnerships, they should also be aware of and attempt to embrace all kinds of unexpected outcomes that come from jointly shaping the future path of their ventures, and thus adopt the flexibility principle of effectuation. Such outcomes may include encounters with a product enthusiast who suggests pursuing a new target market, or negative reviews

in a major press outlet convincing the entrepreneur to work together with the critical expert to redesign certain product features.

Furthermore, our findings show that the ventures of entrepreneurs who behave in a less loss-averse fashion perform better. This negative effect of affordable loss on venture performance, while surprising at first sight, is worth investigating in more detail. Are ventures better off when entrepreneurs focus less on risking only what they are willing to lose? While causal entrepreneurs focus on acquiring the necessary means to achieve pre-determined goals, effectual entrepreneurs are cautious not to commit more resources than they can bear to lose. This allows them to fail cheap and offers them the opportunity for a rapid restart, which might be beneficial to entrepreneurial learning or serial firm development, but which does not necessarily lead to better venture performance. On the other hand, a substantive literature points out that resource commitments are positively related to performance (e.g., George, 2005; Wiklund & Shepherd, 2003). The value of applying the affordable loss principle therefore lies in loss avoidance and not in increased performance, making a negative impact of affordable loss on venture performance more plausible. For entrepreneurs who want to convince investors it is important to keep in mind that, although applying the affordable loss principle might be beneficial for starting a venture, at a later stage a more causal approach may be preferred. Therefore, when seeking investments, the entrepreneur may also want to rely (at least to some extent) on profit forecasts and deliberate sales planning. This tactic does not only contribute to firm performance, but may also persuade investors by signaling the willingness and ability to pursue firm growth future life-cycle stages (Fisher et al., 2016).

Ultimately, we cannot disregard the beneficial effects of causation on venture performance. Our findings are in line with the abundant literature pointing at the advantages of new venture planning (e.g., Brinckmann et al., 2010; Burke et al., 2010; Chwolka & Raith, 2012; Delmar & Shane, 2003; Gruber, 2007). But we

should not infer from these findings that causation is always the more effective entrepreneurial logic for safeguarding venture performance. While previous research has suggested that business planning has a largely positive effect on performance, it also acknowledges the boundary conditions beyond which these findings do not hold. For instance, Gruber (2007) stresses that, in highly dynamic environments, entrepreneurs can profit from planning activities combined with speeding up the planning task. We would welcome future studies explicating these boundary conditions further.

2.5.1.2 Linking Causation and Effectuation to Venture Performance

A second contribution of our work is the insight it provides into the underlying mechanisms linking effectuation and causation to venture performance. As shown empirically, the two constructs are positively correlated and therefore not independent. In fact, we demonstrate that the two logics are mutually reinforcing and contribute jointly to venture performance. Surprisingly, we find that only the effectual principle of experimentation significantly strengthens the relationship between causation and performance. In light of this finding, it may be interesting for entrepreneurs to consider applying a "planning effectuator" approach. Although this seems to be a contradiction in terms, an entrepreneur who designs business strategies for a new venture may still benefit from experimenting with the product offering and making use of the resources at hand (e.g., identity, knowledge, networks). While the effectual approach tends to target the product of the firm, the planning approach allows the entrepreneur to map the general direction in which the business is heading. From a practitioner perspective, entrepreneurs are advised to focus on effectuation while remaining committed to planning mechanisms. Financially healthy firms will continue to use planning, but combine this with an effectual approach. An example is an entrepreneur who may have a desired production schedule for the next year, while at the same time changing the key features of the product based on customer feedback.

2.5.1.3 Future Research Agenda

As a third and final contribution to advance the effectuation literature, we make a plea for focusing on three additional matters in future research. First, we emphasize the need to refine existing, validated measurement scales. Although a detailed discussion of methodological issues of existing scales is beyond the scope of our study, we would like to point out that future research would benefit from further refinement of the effectuation measures developed in the pioneering study by Chandler et al. (2011). They operationalized effectuation as "a formative second-order construct consisting of reflective first-order sub-components" (p. 382). In this conceptualization, effectuation is made up of several decision-making logics representing separate formative dimensions of the effectuation construct. The individual dimensions themselves (i.e., experimentation, affordable loss, pre-commitment, flexibility), however, are treated as reflective in nature (Perry et al., 2012, p. 852). In our view, future research would benefit from refining or expanding the reflective items that ultimately make up the effectuation construct. For instance, the items coding for affordable loss capture financial resources well, but there is still room to also include the other resources the entrepreneur commits to the founding process. For example, Daniel et al. (2014) recommend investigating social losses. In addition, we encourage researchers to closely examine dimensions in the causation construct. Although causation potentially consists of as many dimensions as effectuation, this is often neglected in prior research.

Second, more work is needed to disentangle the nomological web of antecedents and consequences of effectuation (Harms & Schiele, 2012). In addition to creating more clarity with regard to the construct itself, the concept of effectuation may be better positioned in its network of sources, manifestations, and interrelationships. For instance, next to examining the role of individual-level characteristics such as entrepreneurial self-efficacy (Engel, Dimitrova, Khapova, & Elfring, 2014) or identity (Alsos, Clausen, Hytti, & Solvoll, 2016) within the context

of effectuation research, future research could look at antecedents of effectuation at the team or firm level. Also, more research on each of the effectual principles is desirable. For example, while Dew, Sarasvathy, Read, and Wiltbank (2009) examined the affordable loss principle in more detail, other researchers could focus on an entrepreneurs' ability of leveraging contingencies or skillful building of partnerships. Finally, and latching on to our findings concerning the negative relationship between adherence to the affordable loss principle and venture performance, there is a continued need for future studies reflecting on what the appropriate dependent variable for effectuation research ought to be (McKelvie et al., 2013).

Third, more research is needed to further distinguish the concept of effectuation from other entrepreneurial behaviors like bricolage (Baker & Nelson, 2005), improvisation (Hmieleski & Corbett, 2008), and bootstrapping (Bhide, 1991). Fisher (2012) made a first step in this direction by examining entrepreneurial bricolage in comparison with effectuation and causation. Similarly, Welter, Mauer and Wuebker (2016) discussed effectuation and bricolage in the opportunity creation framework, and in their case study Evers and O'Gorman (2011) examined effectuation and improvisation in the context of the internationalization process. Still, additional research is needed to further establish the distinctiveness of the effectuation concept. For example, to what extent is improvisation – the convergence of design and execution (Miner, Bassoff & Moorman, 2001) – an integral part of employing effectual logics? And how does bootstrapping, which relies on the use of limited resources, fit with the means-orientation of effectual entrepreneurs and connect with the affordable loss principle? Future work on the construct clarity of effectuation should address these questions head-on.

2.5.2 Limitations

As with all empirical work, we acknowledge that there are limitations present in our study. As we are working with cross-sectional data, causality cannot be inferred.

Although it is conceivable that entrepreneurs with better performing firms pursue more causal strategies, our data does not allow us to draw conclusions about the order of events. Due to the cross-sectional nature of our research design, we had to ask entrepreneurs about two different (temporal) instances in one questionnaire (i.e., asking them about the approach they chose at the time of venture founding, as well as about current venture performance). Other time-related issues may, however, be more prominent. While we assume the complementarity of the two approaches during the whole venturing process, the sequential use of causation and effectuation is not traceable within our data. That is, the "planning effectuator" might experiment in the early stages of the venture and gradually switch to a more causal approach in later stages. Additionally, recall bias can exist for the independent variables, although we believe that the magnitude of this bias will be limited, given that the ventures in our sample are, on average, five years old. The ability to accurately judge the use of a certain decision-making approach is not likely to depend on details that are difficult to remember after this period of time. Future research, however, should consider longitudinal research designs when linking causation and effectuation to venture performance. It would be advisable to follow founders from the inception of their new venture to later stages, when relevant short-term performance outcomes (e.g., first sale or reaching the break-even point) and long-term performance outcomes (e.g., hire of first employees or consecutive annual sales) can be measured. Questions about the venturing process can then be asked along the way to prevent recall bias.

Another limitation is related to the sample. Respondents come from many countries, and while we control for international differences by grouping them together in country clusters, unaccounted for cultural differences may still be present in our data. Multilevel modeling can account for the nested structure of the data, which is relevant when researchers are interested in explaining any discrepancies between entrepreneurs from different countries. Furthermore, because effectuation

is particularly relevant in environments in which uncertainty is high, it may be interesting to examine the link between country-specific characteristics, such as uncertainty avoidance, and the decision-making behavior of founders. In addition, the use of student samples in research is often criticized due to a purported lack of generalizability (Copeland, Francia & Strawser, 1973; Robinson, Huefner & Hunt, 1991). However, unlike other studies that focus on students with the intention of starting a business after they graduate (e.g., Krueger, Reilly & Carsrud, 2000; Souitaris, Zerbinati & Al-Laham, 2007; Zhao, Seibert & Hills, 2005), we examine student entrepreneurs that are already active. Politis, Winborg and Lindholm Dahlstrand (2011) have demonstrated that student entrepreneurs are comparable to expert entrepreneurs in terms of their reliance on effectual reasoning. Lastly, as addressed in the previous section, our sample does not account for discontinuation of ventures and survivor bias may be present. Therefore, our results apply to operational ventures only.

2.6 Conclusion

With the present study, we aim to advance our understanding of how the interplay of effectuation and causation influences venture performance. Both logics have a claim to success in their own right. As the entrepreneurship literature frequently points out, the adoption of an effectual decision-making logic can be promising for firm founders. However, we caution entrepreneurs and entrepreneurship scholars not to neglect the importance of a planning-oriented, causal approach. When combined with effectuation, causation is beneficial to venture performance. This relationship is driven by experimentation, that is, the ability of an entrepreneur to create opportunities and shape an unpredictable future using the means at hand, while applying the logic of causation and employing traditional business planning activities concurrently. These insights contribute to the existing literature, but also reinforce the call for continued advancement in effectuation research.

CHAPTER

3

Proto-Institutional Emergence in Technology-Driven Contexts: Dialectic Institutional Work in the Dutch Drone Industry

This chapter was prepared in collaboration with Pursey Heugens.

3.1 Introduction

How do regulatory proto-institutions arise in the type of innovation-intensive and behavioral change-prone organizational fields that are emblematic for technology-driven contexts? Prior research in institutional work on the creation of new institutional arrangements has predominantly focused on the relationship between agency and structure, gleaning inspiration from the literature on institutional entrepreneurship (Garud, Jain & Kumaraswamy, 2002; Greenwood & Suddaby, 2006; Maguire, Hardy & Lawrence, 2004). Other authors have stressed that "institutional work insists on the need to consider the permanent recursive and dialectical interaction between agency and institutions" (Lawrence, Suddaby & Leca, 2011, p. 55), thus pointing to the interactive element of institutional work, albeit still focused on the agency-structure relationship. However, a complete picture of institutional emergence requires that we move beyond accounts of how heroic institutional entrepreneurs struggle with fully waxed institutional structures. Especially in the type of innovation-intensive and behaviorally fickle organizational fields that make up technology-driven contexts, our current theoretical understanding of institutional change does not suffice for grasping how multiple key stakeholders, especially entrepreneurs and regulators, shape and are shaped by emerging proto-institutions. In fact, Forbes and Kirsch (2011, p. 589) earlier claim that the study of emerging industries "remains relatively neglected by researchers" in the entrepreneurship domain still rings true today.

In such settings, the grip of proto-institutions – novel normative prescriptions that are not yet fully legitimated and diffused (Lawrence, Hardy & Phillips, 2002; Zietsma & McKnight, 2009) – on entrepreneurial behavior is looser than it is in mature fields. More specifically, because regulators are unable to fully oversee the new realities that emerge from entrepreneurial initiatives in such contexts and, concurrently, are eager to facilitate initiatives that hold the promise of economic development in areas otherwise characterized by low-growth equilibrium

conditions, technology entrepreneurs are given unprecedented freedom to participate in the creation of regulatory proto-institutions. In technology-driven contexts, entrepreneurial behavior itself has thus become an important source of industry regulation in the sense that the regulatory proto-institutional prescriptions entrepreneurs face have, at least in part, sprung forth from their own interactions with regulators. At present, however, we lack theoretical frameworks that capture how entrepreneur-regulator interactions give rise to regulatory proto-institutional emergence in technology-driven contexts. Our aim with this study is to develop a process-theoretical account of these dialectic interaction patterns between entrepreneurs and regulators, based on multiple complementary sources of longitudinal qualitative data. We thus set out to document the micro-momentary actions through which entrepreneurs shape their own regulatory contexts in interaction with regulators. These actions have a profound conditioning effect on the opportunity and constraint structures facing later-generation entrepreneurs.

Our study is set in an organizational field that is wholly representative of technology-driven contexts: the Dutch industry for businesses that produce, commercially operate, and/or deliver services for remotely-piloted aircraft systems (RPAS), colloquially referred to as "drones". We rely on several sources of longitudinal qualitative data, including participation in industry events, analysis of archival data, field notes and personal observations, as well as twenty-seven semi-structured, in-depth interviews with industry participants. Our analyses show how the regulatory proto-institutions in this field have emerged in four consecutive evolutionary phases. Proto-institutional structures emerge in each phase as a joint entrepreneurial and regulatory response to challenges and opportunities experienced in prior phases. At the same time, new structures also give rise to institutional frictions[9], which continue to mount until they cause an institutional transition that

[9] Institutional frictions arise when institutional arrangements become increasingly inapt at remedying the social or economic problems for which they were once designed, causing the actors embedded in and dependent upon these institutions to search for alternative solutions or develop costly workarounds.

sounds in a next evolutionary phase (Padgett & Powell, 2012; Schneiberg, 2006). Our results thus have a strong processual character, in that entrepreneur-regulator interactions occur in different phases of the proto-institutional emergence process, and play a central role in moving the emergence process along from one phase to the next.

Our study makes three contributions. First, by introducing the concept of dialectic institutional work, we go beyond the commonly researched interplay between agency and structure to illustrate how diverse entrepreneur-regulator interactions in technology-driven contexts contribute to proto-institutional emergence. We specifically build on Lawrence and associates (2011, p. 56), who state that "[e]xamining institutional work in the context of emergent institutional processes points to the actions of those who affect, or attempt to affect, institutional processes at both the general and the local levels." Following these authors' advice, we apply the institutional work lens to analyzing the emergence of proto-institutions in technology-driven contexts. This is in line with work by Ozcan and Gurses (2018, p. 1811) who point to the need "to consider the various contradictory and complementary institutional work done by the different actors involved in institutional processes (Delbridge and Edwards, 2008)". Second, by translating our findings into a clear framework, we also show how entrepreneurs and regulators create new proto-institutions in technological innovation-intensive fields. Specifically, we contribute to literature on institutional emergence (Padgett & Powell, 2012) by documenting the processes through which proto-institutions evolve. In doing so, we respond to a call by McMullen and Dimov (2013) for more process-oriented approaches in entrepreneurship studies and the "need for more studies to clarify how scholars, managers and policymakers can better understand and interact with emerging industries" (Forbes & Kirsch, 2011, p. 590). Thus, we

Such frictions derive from an incoherent configuration of elements within an institutional arrangement or from "duels" between competing arrangements (Yiu, Hoskisson, Bruton, & Lu, 2014).

advance our collective understanding and show that under conditions of radical technological change and frequent behavioral adaptations (Hitt, Keats & DeMarie, 1998; Verbeke, 2018), entrepreneurs and regulators face greater uncertainty and interdependence than in mature organizational fields, leading them to engage in dialectic institutional work. We expect that the resultant process of proto-institutional emergence we document will generalize towards other nascent fields facing technological innovation-intensive conditions, including blockchain-based cryptocurrencies, platform-based sharing economy firms, and decentralized renewable energy generation. In all these cases, entrepreneurship around innovation also engenders regulatory institutional change.

3.2 Literature Review

Entrepreneurs face uncertainty regarding the future of their ventures, not only due to the uncertain nature of the business itself, but also because of uncertainty in the business environment (Ahlstrom & Bruton, 2010; Ozcan & Gurses, 2018). This is especially true in technological innovation-intensive fields, in which institutionally determined opportunity and constraint structures are still in flux. Whereas it used to take decades for industries to mature, following a fairly predictable pattern of industry evolution (Aldrich & Ruef, 2006; Klepper & Graddy, 1990), institutional emergence in technological innovation-intensive fields is more rapid and less predictable due to the impact of radical technological change and frequent behavioral adaptations of involved stakeholders (Verbeke, 2018). We therefore need new frameworks to help us understand how regulatory proto-institutional structures emerge in these novel contexts. The literatures on institutional work and proto-institutional emergence offer excellent points of departure for developing these new frameworks.

3.2.1 Institutional Work

Institutional work describes the "purposeful action of individuals and organizations aimed at creating, maintaining and disrupting institutions" whereby scholars of institutional work have been concerned with "understanding the role of actors in effecting, transforming and maintaining institutions and fields" (Lawrence & Suddaby, 2006, p. 215). Institutional work activities have previously been documented in the literatures on institutional entrepreneurship, institutional change, and deinstitutionalization (Lawrence, Suddaby & Leca, 2009). In theorizing the process of institutional creation, Lawrence and Suddaby (2006, p. 221) distinguish between three sets of practices. These start with "overtly political work in which actors reconstruct rules, property rights and boundaries that define access to material resources", which they refer to as vesting, defining and advocacy work. The authors then point to work directed at changing norms as well as constructing identities and networks "in which actors' belief systems are reconfigured". Lastly, actions aimed at mimicry, theorizing, and educating involve "abstract categorizations in which the boundaries of meaning systems are altered".

The focus in institutional work lies on the actions taken by individuals or organizations in relation to institutions, thus putting more emphasis on agency than early neo-institutional studies (DiMaggio, 1988; Fligstein, 1997; Oliver, 1991). Whereas earlier studies in the neo-institutional tradition tended to focus on the impact of institutionalized norms on organizational structures, recent research puts more emphasis on agency – up to the extent that entrepreneurs are portrayed "as powerful, heroic figures able to drastically shape institutions" (Lawrence et al., 2009, p. 3). Indeed, institutional entrepreneurship can be seen as one stream of research within the institutional work framework (Lawrence & Suddaby, 2006, p. 216). However, it has also been argued that the creation of new institutions requires more resources and mobilizing power than what can be mustered by even the most heroic of institutional entrepreneurs; the institutional work needed to create new

institutions inevitably has to draw on a broader collection of actors. These are not only institutional entrepreneurs, but also actors "whose role is supportive or facilitative of the entrepreneur's endeavours" (Lawrence & Suddaby, 2006, p. 217; Leblebici, Salancik, Copay & King, 1991).

While the institutional entrepreneurship branch of the institutional work literature predominantly focuses on the entrepreneur as the most important actor in creating new ventures, markets, and organizational fields, the relationships between entrepreneurs and other stakeholders should thus not be disregarded. Lawrence et al. (2011, p. 54) stress that it were Berger and Luckmann (1966) who already pointed out that the creation of new institutions is "arising directly from reciprocal typifications that occur in the habitual interaction of individuals". Consideration of these interactions and relationships is crucial for understanding the interpretative activities underlying the interactive institutional work processes leading to the creation of new proto-institutions. In technological innovation-intensive fields in particular, new opportunity and constraint structures tend to emerge out of the recursive interactions and relationships between entrepreneurs and regulators, with neither party being clearly in the lead of this process.

3.2.2 Proto-Institutions

Proto-institutions are "institutions in the making" (Lawrence et al., 2002, p. 283). They consist of practices, rules, and technologies that are not yet fully established, but have the potential to become conventional institutions once they are accepted and diffused throughout the field. Thus, they form "a particular set of institutional arrangements as a solution to some problem" (Zietsma & McKnight, 2009, p. 148), where this 'problem' often arises from novel practices, rules, and technologies that have no standardized or institutionalized way to be dealt with. Unsurprisingly, proto-institutions are more likely to be found in emergent fields and in technological innovation-intensive fields (Maguire et al., 2004).

Research on proto-institutions tends to focus on collaboration, co-creation, or partnerships to explain the processes that shape the emergence of future institutions. In their study of an NGO in Palestine, Lawrence and colleagues (2002) zoom in on interorganizational collaborations to explain the emergence of proto-institutions, while Boxenbaum (2004) classifies the emergence of diversity management as a new practice in the Danish context as a proto-institution. Zietsma and McKnight (2009) study the Canadian coastal forest industry and identify co-creation processes that occur when proto-institutions form. Webb, Kistruck, Ireland and Ketchen Jr. (2010) take a different approach when they conceptualize proto-institutions as network-level influences that help multinational enterprises overcome institutional-level obstacles. Helfen and Sydow (2013, p. 1079) define proto-institutions as "the *institutional* outcomes of negotiation work" (emphasis in original), and Hensel (2018, p. 225) investigated organizational responses to proto-institutions in an effort to show "how clashes of semi-edited and unedited accounts about the proto-institution affected its adoption and implementation." With a slightly different focus, but related to proto-institutions, is the description of Marti and Mair (2009, pp. 109-111) of provisional institutions. These are instrumentally built institutions that serve a temporary interest (in the case of the authors: poverty alleviation) for a certain period of time. In comparison to proto-institutions as discussed previously, provisional institutions are created with the intention of being a transitional means to an end. The proto-institutions that we explore go beyond temporary structures, however, in that they spring from mutual interaction patterns involving multiple stakeholder groups, whose intent it is to let these institutions acquire a more permanent character.

In sum, different actors are involved in shaping the landscape by means of their active participation in emerging technological innovation-intensive and behaviorally fickle contexts. As new practices emerge and new rules form, regulatory proto-institutions are created as a pragmatic response to recurring

problems in areas like public safety and privacy. Exploring the institutional work involved in creating these "candidates for institutionalization, if only enough members of the field will adopt them" (Zietsma & McKnight, 2009, p. 148) in the context of technology-driven fields is vital. Therefore, the research question that our study addresses is: *How do regulatory proto-institutions arise in the type of technological innovation-intensive and behavioral change-prone organizational fields?*

3.3 Methods

To address our research question, we relied on qualitative data from multiple sources, which allowed us to build theory inductively on the basis of a continuous analysis of the data. We compared our ongoing analyses to new insights, while remaining open to new themes emerging directly from the data, thus following an iterative process of data collection and analysis (Reay & Jones, 2016). We continued our data collection and analysis efforts until theoretical saturation was reached – the point at which no or few new insights could be generated by including more data. This is the best suited methodology for engaging with the under-researched theme of proto-institutional emergence in technological innovation-intensive fields because we witnessed many ongoing developments as they took place. The processual nature of our research question, asking the 'how' type of question, allowed us to generate the type of deep insights that only qualitative data is able to provide (Barley, 1990; Langley, 1999).

3.3.1 Research Context: the Dutch RPAS Industry

The International Civil Aviation Organization (ICAO) defines RPAS as a "set of configurable elements consisting of a remotely-piloted aircraft, its associated remote pilot station(s), the required command and control links and any other system elements as may be required, at any point during flight operation" (ICAO

Circular 328, p. 12). [10] Initially, RPAS were developed and tested for military purposes, with the first 'drones' being launched during World War I (Austin, 2011). However, conceptions of flying machines date back to about 2500 years ago, when engineers in ancient Greece were interested in building mechanical birds or when, in China, a wooden hawk was developed (Dalamagkidis, Valavanis & Piegl, 2012). In the recent past, RPAS have been used in military conflicts and war zones. They have been used in Afghanistan, for example, since 2001, for carrying out targeted kill missions (Gregory, 2011; McBride, 2009). Only recently have RPAS begun to be used for civil purposes (Braun, Friedewald & Valkenburg, 2015). The Dutch industry for commercial RPAS emerged from the leisure-driven market for model airplanes. At the beginning of the 21st century, aircraft systems became more affordable and available to a broader public. This process was facilitated by the rise of mass-market producers such as the Chinese DJI, with their flagship aircraft, a quadrocopter called the "Phantom" (The Economist, 2015).

The Dutch RPAS industry is an appealing setting in which to study the emergence of proto-institutions characteristic for technology-driven contexts for three reasons. First, entrepreneurial activity around the use of RPAS has increased over the past several years and technology in this area continues to develop quickly. Not only is flying an RPAS seen as an entertaining leisure activity, but many companies have formed around them, either as operators, producers, or in related services for RPAS users (such as consultancy, online applications, or training). On the one hand, this offers a wide range of opportunities for entrepreneurs. On the other, this development also has implications for the broader group of stakeholders in the industry, including policy makers and citizens whose physical safety and privacy may be threatened by the use of RPAS. Second, the global sales of

[10] Note that we will refer to RPAS (Remotely Piloted Aircraft Systems) in the remainder of this paper. Others refer to UAV (Unmanned Aircraft Vehicle) or UAS (Unmanned Aircraft System) more broadly. Although "drones" colloquially capture a wide variety of unmanned aircraft, the term historically has a rather negative connotation.

commercial RPAS are estimated to yield 4.8 billion US Dollars (USD) in 2021, a remarkable increase from 608 million USD in 2014 (WinterGreen Research, 2015). In Europe alone, this industry is expected to generate 10 billion Euros annually by 2035 and over 15 billion Euros annually by 2050 (SESAR, 2016). This illustrates the relevance of our research setting, not only for the Netherlands, but also in terms of industry development internationally. Third, the field is currently in its formation phase and many developments – be they technological or regulatory – are still unfolding. Efforts have been made to draw up regulatory instruction guides along the way, such as a roadmap issued by the European RPAS Steering Group in 2013 and a 'prototype' regulation document put forward by the European Aviation Safety Agency (EASA) in 2016. However, only in 2018, EASA was granted the EU-wide rule-making competency for all civil drones.[11] In spite of these efforts, the actual implementation is yet to be done and harmonized rules applying to the international airspace (similarly to manned aviation) remain years away. As such, an established institutional framework is not yet in place and development in this industry is still ongoing.

3.3.2 Data Collection

Our study includes data derived from active participation in the field, archival data and interviews. This is in line with what Gioia, Corley and Hamilton (2013, p. 19) regard as "good qualitative research"; namely, drawing from several qualitative sources with an emphasis on field observation and archival data while at "the heart of these studies is the semi-structured interview". We conducted our interviews and field research between February 2015 and June 2017 and performed archival research between February 2015 and October 2018. Our geographical focus is on

[11] It should be noted that before June 2018, only aircraft with a weight of more than 150 kg were bound to be regulated by EASA. Aircraft that are lighter were regulated by each country's national aviation authorities. On top, ICAO aims to provide an international regulatory framework.

the Netherlands, but we also took Europe-wide and even worldwide developments into consideration to be able to draw the bigger picture.

3.3.2.1 Field Work

In addition to six industry conferences, one held by the American RPAS industry association with a focus on European developments (Unmanned Systems Europe), two held by the European RPAS industry associations (RPAS CivOps and RPAS Civil Policy), one European business-to-business conference (SkyTech), one European logistics conference (Unmanned Cargo Aircraft Conference) and one Dutch logistics conference (Airneth), we also attended meetings held by the Dutch RPAS industry association (DARPAS), as well as a public parliament meeting at the Dutch House of Representatives. Notes were taken during or after these meetings to supplement the more personal accounts of the interviewed informants. In general, we tried to immerse ourselves in the field in an ethnographic manner, using field notes to structure our primary data collection and field experiences. Forbes and Kirsch (2011) stress that a 'real-time' approach is particularly well suited to study the emergence of a new field. We spent about 75 hours at these conferences, workshops, and meetings. In addition, most interviews conducted with entrepreneurs were combined with a visit to the entrepreneurs' firms, to get an impression of their work environment. Products were shown and informal conversations were held with the interviewees, as well as with the other employees who were present. The time spent at these entrepreneurs' firms adds approximately 15 hours to the total time spent conducting fieldwork. Throughout the data collection period, we maintained our awareness of the risk of becoming too close to the data, as too much researcher involvement can lead to the blind adoption of the point of view of the study's subjects. In an effort to avoid this, we followed Gioia and associates' (2013) lead by having one author adopt an outsider perspective, i.e. abstaining from being involved in actual fieldwork and critically reflecting on all accounts by playing the devil's advocate.

3.3.2.2 Archival Data

We also collected presentations that were given at industry gatherings. In total, we drew on 3,593 slides that made up 240 presentations held at eleven industry conferences, workshops or seminars, of which we attended six. Two videos that were shown during these meetings were also included. Regulators and government representatives are often invited to engage in conversation with industry stakeholders and, as such, these presentations are an important source of information on the perspective of regulators. For instance, new policy plans were communicated during these presentations and updates were given on progress made by governmental working groups. As presentations are widely used to communicate and exchange ideas, they are particularly well suited to use in our analysis. Please see Table 3.1 for a description of the archival data we used.

Conference/Workshop	Date	Total No. of Presentations (Slides)	Of Which: Entrepreneurs/ Firm Representatives	Of Which: Regulators	Of Which: Other Stakeholders
AUVSI Unmanned Systems Europe, Brussels (Belgium)	3 March 2015	18 (234)	4 (51)	11 (164)	3 (19)
ICAO's First Global RPAS Symposium, Montreal (Canada)	23/24/25 March 2015	86 (1405)	14 (242)	48 (785)	24 (378)
Skytech, London (United Kingdom)	24 April 2015	9 (186)	4 (72)	-	5 (114)
Workshop on Drones by the Dutch Ministry, The Hague (Netherlands)	28 May 2015	7 (52)	2 (25)	4 (16)	1 (11)
RPAS CivOps - The European Civil RPAS Operators' Forum, Brussels (Belgium)	19/20 January 2016	28 (425) *also* two videos	9 (158)	10 (122)	9 (145)
EUROCAE Workshop, Brussels (Belgium)	4 March 2016	10 (153)	1 (16)	3 (35)	6 (102)
3rd International Unmanned Cargo Aircraft Conference, Enschede (Netherlands)	26 May 2016	8 (153)	3 (63)	-	5 (90)
EASA Workshop on Drones, Cologne (Germany)	20 June 2016	12 (141)	-	7 (89)	5 (52)
High Level Conference on Drones, Warsaw (Poland)	24 November 2016	30 (295)	7 (47)	13 (144)	10 (104)
Airneth Seminar on UAVs, The Hague (Netherlands)	8 December 2016	3 (53)	2 (35)	-	1 (18)
European Civil RPAS Policy, Regulatory & Innovation Forum, Brussels (Belgium)	13/14 June 2017	29 (496)	9 (161)	8 (114)	12 (221)
TOTAL		**240 (3593)**	**55 (870)**	**104 (1469)**	**81 (1254)**

Table 3.1 Overview Archival Data

3.3.2.3 Interviews

We conducted a total of 27 semi-structured, in-depth interviews, of which 20 were held with Dutch entrepreneurs, four with representatives of regulatory bodies[12] and three with other stakeholders (one being a commercial pilot working for a start-up RPAS manufacturer, one being the director of geo-information at an aerial mapping company using drones as a new tool in their business, and one being an employee of an intergovernmental economic institution dealing with RPAS-related topics). In doing so, we relied on a theoretical sampling approach. After the initial introduction provided by the chairman of the Dutch RPAS association, we approached several entrepreneurs for an interview. At the end of each interview, the interviewee was asked to refer us to other key players in the field, based on the categories and themes that emerged during the interview. Ultimately, by following up on our emerging theoretical ideas, we construed a sample that included various businesses, producers, operators and service providers, as well as entrepreneurs who had discontinued their venture. Please see Table 3.2 for a description of the sample.

[12] We refer to representatives of regulatory bodies when describing individuals representing governmental authorities, such as national regulators, supervisory bodies, other European and Dutch legislative agencies or supra-national mandated workgroups. These are decision-makers shaping, implementing and monitoring the regulatory context (Elert, Henrekson & Wernberg, 2016).

Respondent	Classification	Firm Description	Function
R1	Service provider (non-flying)	Consultancy	Self-employed
R2	Manufacturer	Manufacturing	Co-founder, CTO
R3	Service provider (non-flying)	Consultancy, conference organization	Founder, CEO
R4	Service provider (non-flying)	ICT solutions	Self-employed
R5	Manufacturer	Manufacturing	CEO
R6	Manufacturer, operator	R&D, manufacturing	Co-founder, CEO
R7	Operator	Inspection, search and rescue, mapping, remote sensing	Co-founder, marketing & sales director
R8	Operator *(firm discontinued)*	Emergency response, law enforcement, security	Co-founder, COO
R9	Operator	Bird pest control	Co-founder
R10	Operator	Energy generation	Co-founder, director
R11	Operator *(firm discontinued)*	Aerial mapping, remote sensing	Founder
R12	Operator	Film and photography	Co-founder, managing director
R13	Manufacturer	Manufacturing	Compliance officer
R14	Operator	Inspection, security, mapping, aerial imagery	Co-founder
R15	Governmental institution	Governmental institution	Supervisory body
R16	Governmental institution	Governmental institution	Supervisory body
R17	Operator	Film, inspection	Founder
R18	Operator	Geodata	Director geoinformation
R19	Manufacturer, operator	Medical supply, traffic management, IT solutions	Founder
R20	Manufacturer	Manufacturing	Co-founder
R21	Intergovernmental economic institution	Intergovernmental economic institution	Economist
R22	Operator	Film and photography	Self-employed
R23	Operator	Film and photography	Self-employed
R24	Governmental institution	Governmental institution	Rule-making body
R25	Governmental institution	Governmental institution	Rule-making body
R26	Operator	Film & photography, service platform, inspection	Co-founder
R27	Operator	Film & photography, service platform, inspection	Co-founder

Table 3.2 Interview Sample Overview

All interviews were conducted in Dutch, with the exception of one interview held in English. The questions were open-ended and probing was used to give interviewees the space to express deep thoughts and elaborate on answers. These interviews were conversational, but we did make use of an interview protocol to ensure that certain key topics were covered in all conversation (see Table 3.3 and Table 3.4). As Gioia and colleagues (2013) suggest, all questions were focused on our research question but did not lead the respondents in any particular direction. We started out by asking the entrepreneurs about the process of starting their own business, the approach they took during their venturing endeavors, the current situation and problems they might be facing (both in the Netherlands and abroad), as well as their views on future developments. Regulators were asked about their work practices related to RPAS, their interaction with entrepreneurs, as well as their views on the current situation, problems they face in their work, and future developments both domestically and EU-wide. Interviews with other informants were used to obtain an alternative perspective and were treated as background information in an effort to understand multiple viewpoints on the issue at hand. These interviews also, in large part, followed the entrepreneurs' interview protocol. Most interviews were conducted face-to-face (N=20) and where that was not possible, they were conducted over the telephone (N=7). We translated the interview quotes we used to illustrate our findings into English ourselves, but had the translation reviewed by an English native speaker conversant in Dutch.

All interviews were recorded and transcribed verbatim. In a single case (Respondent 21), the recording device did not work and an interview summary was written afterwards. On average, interviews lasted about 75 minutes. We obtained a total of 446 pages of transcripts (Arial, 11 pt., single line-spacing) from the almost 30 hours of interviews.

Topic Area	Sample Questions
Venture founding	• How did you start your business? • What kind of resources were important to use? How did you get them?
Interactions with regulators	• How important do you regard relationships with government institutions? • Could you please describe the kind of interactions you have with regulators?
Industry context	• What does it mean to you to be an entrepreneur in the RPAS industry? • How do you keep up with (regulatory) developments in the industry?
Regulatory developments	• Are you more focused on Dutch or European rules and regulations? • Where does the industry stand in five years concerning rules and regulations?

Table 3.3 Interview Protocol Entrepreneurs

Topic Area	Sample Questions
Work practices	• How did your work change since RPAS became more popular? • Can you describe some of the problems you face in your work?
Interaction with entrepreneurs	• How does the interaction with entrepreneurs look like? • How flexible are you in helping entrepreneurs?
Industry context	• What will be more important in the future, Dutch regulations or Europe-wide ones? • What are your thoughts on illegal operations/flights?
Regulatory developments	• What are remaining, important questions that need to be answered in the future? • What do you expect will change within the next five years?

Table 3.4 Interview Protocol Regulators

3.3.3 Data Analysis

We adopt an interpretivist epistemology in this study, consistent with the constructionist research stream, which posits that the social world is constructed through the actions of individuals acting upon it (Charmaz, 2014). In analyzing our qualitative data, we employed a pattern-inducing technique in which "researchers gather empirical textual data that range from interview to direct observation and often include personal experience, […] cluster text segments in meaningful categories that they believe reveal actor behaviors […and…] make sense out of the grouped data" (Reay & Jones, 2016, p. 449/450). We analyzed our data using NVivo 11. Archival data was first sorted into three categories – presentations by entrepreneurs, presentations by regulators, and presentations by other stakeholders – and were then analyzed. Presentations by other stakeholders include those given by universities, lawyers, industry associations, test sites, training and certifying agencies, research institutions and industry consortia, to name a few. Naturally, our own presentations were excluded from the analyses. During the first step, open coding, we stayed close to the participants' vocabularies and sorted information into meaningful categories. Afterwards, we went through the codes and looked for connections between the direct information gathered from the first step in the analysis process. From this, broad themes emerged. Finally, we grouped themes together, which led to the overall constructs that are an important part of our process model, the diverse entrepreneur-regulator interactions. Table 3.5 displays the codes, broader themes and overall constructs.

Entrepreneurs' Perception: Rules apply/are followed			
Regulatory Context as Enabling		**Regulatory Context as Constraining**	
Regulation as precursors of competitive advantage - Adherence to strict rules guarantees high quality operations ("if you can fly in NL, you can fly everywhere") - Knowledge of rules in manned aviation helps to understand how the system works and why rules are important - Difficult regulatory framework allows for specialisation, offer clear advantage	Rules as conduit for good regulatory relations - Feeling of ownership of rules, having a say in it - To be taken seriously you need to play by the rules - Government is partner, not enemy	Regulatory attempts lagging practice - It is all about "politics", unclear who decides and how - Technology and market are ready and developed, only laws are not - Regulators do not understand the needs of entrepreneurs - Rules that apply to manned aviation are falsely translated to drones	Regulations are unnecessarily limiting - Too many restrictions as to what is allowed, too much uncertainty - Long and exhausting process as rules change continuously, frustrating - Better to go abroad, to other countries where more is allowed
Entrepreneurs' Perception: Rules do not apply/are not followed			
Disregarding Regulatory Context		**Exception in Regulatory Context**	
Regulation has no direct effect - Rules do not directly affect service provider, can adjust to changes	Regulation is not adhered to - Consequences for unlawful behavior are low/cheap - Taking risks without considering or being aware of consequences, e.g. crash into big crowd - 'Forced' into illegal behavior (government too slow, rules too difficult) - Want to be responsible, but lack knowledge ("they don't know enough")	Regulation needs to be more nuanced - Rules currently do not cover different applications, user groups - Procedures do not match reality, so one should not obey - What is allowed for leisure users should also be allowed for commercial users - Rules for manned aviation are falsely translated to drones	Regulations openly disregarded - Rules may not be followed, but this is also communicated to regulators

(table continues on next page)

Regulators' Response: Facilitating			
Co-Creation through Rule Selection		**Co-Creation through Rule Refinement**	
Regulatory change stems from learning - Learning and gaining experience is part of the process ("flexibility in the rules is essential") - "Reflect state of the art: best practices based on best available evidence and analysis"	Regulatory change based on external forces - When EU-wide regulations come into place, certain rules will need to be abandoned	Regulation as starting point for discussion - New regulation for mini-drones was implemented to lower the threshold of operating according to rules - Rules did not take producer/test sites into account, but will be adjusted to facilitate entrepreneurs' needs - It is easier for professional firms that are known for safe operations to "get things done" their way	Regulation as inclusive as possible - "Need to obtain buy in from all involved parties" - "One size does not fit all"
Regulators' Response: Restricting			
Compliance through Rule Reinforcement		**Compliance through Rule Proliferation**	
Regulation as given basis for operation - Rules apply to the majority of cases, need to be followed - "Operate within the bounds of existing legislation"	Regulation due to newness of RPAS - Basis for all rule-making is aviation law and its principles need to be reinforced - RPAS will have to prove to be as safe as current manned vehicle operations	Regulation disobeyed unintentionally - Lack of understanding of complex rules - Lack of awareness of current rules - Informing customer sufficiently so that illegal operator would not be chosen again	Regulation and monitoring increasing - "more specific rules" for RPAS that weren't needed in manned aviation before - Pressing charges, increasing monitoring by police

Table 3.5 Data Structure

We then turned to Langley and colleagues (e.g. Langley, 1999; Langley & Abdallah, 2011; Langley, Smallman, Tsoukas & Van de Ven, 2013) and followed their methodological recommendations for process research. We teased out re-occurring interactions between regulators and entrepreneurs, and questioned their underlying beliefs and behavioral motivations. To validate these findings, we presented them to a variety of stakeholders at a conference where both entrepreneurs and regulators were present. Through discussion, we sought to understand whether the framework we saw emerging from the data matched the perceived reality of industry insiders. Our findings were positively received and confirmed. In the end, no comments were made that led to major changes of the regulator-entrepreneur interactions we found to be characteristic for our research setting. We also built a chronological timeline detailing more than 65 events and occurrences relating to the development of the RPAS industry in the Netherlands, the EU, and worldwide. We then employed temporal bracketing to meaningfully categorize these events (Langley, 1999). We looked for time spans that were internally homogeneous and externally heterogeneous. This allowed us to differentiate between four distinct evolutionary phases, which were included in the model we build. Finally, we placed the entrepreneur-regulator interactions we uncovered in the timeline of events. This allowed us to go beyond a purely synchronic illustration of interactions, which tends to "freeze time" (Barley, 1990, p. 223), and rather present a fully diachronic analysis of how regulator-entrepreneur interactions shape and are part of the process by which proto-institutions arise. As the resulting visual representation is rather stylized, we stress that in reality there is overlap between phases and interactions.

3.4 Findings

3.4.1 Overall Process of Proto-Institutional Emergence

The process by which regulatory proto-institutions in the Dutch RPAS industry emerge is best typified by cooperation between rule makers and

entrepreneurs, rather than by a top-down approach in which regulators dictate the terms. A Dutch regulator proudly described the Dutch approach as one that is "flexible" and built on "co-creation" (presentation at European Civil RPAS Policy, Regulatory & Innovation Forum, Brussels, 2017). At the EU level as well, the rules proposed by EASA are seen as "tentative and […] presented to generate a debate" as regulators "need feedback from industry now" (presentation at EASA Workshop on Drones in Cologne, 2016). The European Organisation for Civil Aviation Equipment (EUROCAE), an organization that develops aviation industry standards, summarized the process as: "industry and regulator → working together" (presentation at High Level Conference on Drones in Warsaw, 2016). A representative of EUROCONTROL, the European Organisation for the Safety of Air Navigation, speaks of a "[p]ragmatic European approach" (presentation at AUVSI's Unmanned Systems Europe in Brussels, 2015) when discussing current rule-making efforts. In a report on the safe use of RPAS, the European Parliament issued a statement in which it "considers that the industry, regulators, and commercial operators must come together to guarantee legal certainty" (European Commission, 2015). The need for a joint approach is thus recognized by a variety of parties, both domestically and at the EU level.

Our evidence shows that Dutch rule makers are aware of their knowledge gap, and actively approach industry stakeholders to find workable solutions. Rule makers had to rely on their "gut feeling" in the past (Respondent 25). As the minister of Infrastructure and Environment pointed out during a committee meeting, regulators may even need to make arbitrary decisions in order to elicit feedback from the entrepreneurs who will be subjected to the new regulations. She explained how the four kilogram weight limit was chosen for newly proposed regulations covering so-called 'mini-drones':

> *I was wondering myself why four kilograms was chosen and not, for example, one kilogram. You can see a variety of weights in our neighboring countries, and there are hardly any rules for drones from one to seven*

> *kilograms. (...) Four kilos has been chosen as it is the middle of one and seven kilograms, and was intended as a starting point for discussion with the drone industry. Consultations with the industry have shown that a limit of one kilogram is acceptable for a drone where there are no demands of the pilot and that does not require separate examination. (...) We want to make rules that allow for innovations.* (Dutch House of Representatives, 2015).

This quote illustrates the willingness of regulators to involve the people that will ultimately have to deal with the new regulations. Entrepreneurs welcome this openness and are happy to contribute to shaping the nascent regulatory context. One respondent, an entrepreneur with many years of industry experience and one who has started a number of firms, describes this process as follows:

> *We are simply trying to create a commercial company which meets all the requirements of the government and also cooperates. We're also working with them, we work very well together with the government, and I have been allowed to advise both the Dutch government and European authorities concerning regulations. Purely because we know what we are talking about. If you're sitting in a meeting with relevant European stakeholders, then I'm the only one who actually flies [a drone] and knows what he's talking about.* (Respondent 11).

Regulators, of course, have a different perspective on developments within the emerging industry than entrepreneurs do. Entrepreneurs not only have more extensive knowledge of the market, but can also draw on different formative past experiences. An interactive process thus enables rule makers, as well as entrepreneurs, to be freed from wrongful assumptions about the status quo. This is illustrated by a conversation one of the interviewed entrepreneurs had with an employee of the Environment and Transport Inspectorate, an agency of the Ministry of Infrastructure and Environment:

> *Sometimes a person [at that agency] who sits behind his desk has very different ideas. I've had this conversation many times, [they say]: 'You are a commercial operator, so you always go one step further.' I think that is very illogical. I put my business at stake, which means that I will never go as far as a hobbyist would. I am exercising much more caution. They had a*

> *very different perception. They thought that there is a commercial interest behind it, there is money to be earned, so you take more risks. (…) We do not operate a 1,500 Euro system, we use systems that cost 20,000 or 30,000 Euro, so you won't take any risks, because again, that is a risk to your business. You don't do that, while they [the agency] had a very different belief, which was quite striking.* (Respondent 7).

Other advisory bodies, like the Joint Authorities for Rulemaking of Unmanned Systems (JARUS), which includes representatives from 50 countries and contributes to the development of an RPAS regulatory framework for the safe integration of RPAS into airspace, include a separate stakeholder team into their structure. They recognize "[p]artnership as the key to success" and require '[b]road stakeholder involvement." Thus, JARUS created a Stakeholder Consultation Body ensuring that industry stakeholders, such as manufacturers, industry associations, air navigation service providers, standardization bodies, operators and pilots are involved (presentation at EASA Workshop on Drones in Cologne, 2016; RPAS CivOps in Brussels, 2016). The same goes for other EU agencies, as an EASA representative states that they are "committed to work in cooperation with all stakeholders" (RPAS CivOps in Brussels, 2016). The Swiss Federal Office of Civil Aviation even believes that "a smart regulator (…) is part of the Drone Ecosystem [and] develops with the Ecosystem standard scenarios to reduce the authorisation effort and the administrative burden" (presentation at EASA Workshop on Drones in Cologne, 2016). Thus, the intention to develop the regulatory context together, even at the broader EU level, is inherent in the RPAS industry.

While the regulatory process is Europe is collaborative in nature, this does not mean that it is easier or faster than regulatory processes elsewhere. Entrepreneurs who hope to move forward as quickly as possible still tend to experience the process as tiresome. Respondent 5, for example, stated that "the rule making, how it goes with these agencies, I find it really tiring, extremely slow".

Having presented our insights into the process, we now turn to the different phases that characterize proto-institutional emergence in the Dutch RPAS industry and the distinct entrepreneur-regulator interactions that gave rise to proto-institutional emergence during the study period.

3.4.2 Phases of Proto-Institutional Emergence Driven by Distinct Entrepreneur-Regulator Interactions

We distinguish between four phases of proto-institutional emergence in the RPAS industry between 2000 and 2018. Each phase spans two to five years, and includes seven to 28 events. Table 3.6 presents a detailed timeline of these events relevant for the Dutch, EU, and international context. We observe several cascading effects (Verbeke, 2018) through which international and EU-level developments influence Dutch regulatory developments and condition the activities of actors within the Netherlands. The separate phases represent a way to map the process of proto-institutional emergence. We illustrate which interactions between entrepreneurs and regulators give the impetus for proto-institutional emergence. We find that RPAS entrepreneurs share two fundamental beliefs about the nature of the regulatory environment. They either recognize the existence of rules they need to adhere to, or they perceive the rules as extant, but not applicable to themselves. Between RPAS regulators, we find two different beliefs about how best to create the regulatory context. They either hold a facilitating view of what the new regulatory context should entail, or have a more constraining take on the regulations to be established. Although we label certain regulators' responses to entrepreneurial activities as constraining, rule makers were generally open to input from industry stakeholders ("EMPOWER Stakeholders" as demanded by ICAO; presentation at High Level Conference on Drones in Warsaw, 2016). Whereas regulations can be constraining, the regulatory process is highly collaborative, as illustrated in the previous section.

Date	Event	Content	Scope	Source(s)
		Phase 1: Recognizing Future Potential (2000-2004)		
January 2000	Founding of European industry association UVSi[i]	"Started in 1995, as EURO UVS (European Unmanned Vehicle Systems Association), this non-profit organisation […] changed its statute and its name to UVS International, in order to better reflect its global character and reach."	EU	UVS International, General Information
June 2001	EU funded workshop on UAVs	"…increase the awareness in the European community regarding the rationale and the benefits of potential civilian missions using UAV's."	EU	UAV civilian application workshop: environment/ communication/safety
July 2002	Establishment EASA[ii]	Decision by the European Parliament and the Council of the European Union to establish a common European Aviation Safety Agency.	EU	(EC) No. 1592/2002
July 2002	European Commission publishes aerospace policy framework	First recognition and mention of unmanned aircraft systems by the European Commission.	EU	STAR 21, Strategic Aerospace Review for the 21st Century
September 2002	Joint JAA[iii]/ EUROCONTROL[iv] Task Force on UAVs	"A joint Task-force is justified by the close relation between ATM [Air Traffic Management] issues and aircraft issues in the case of UAV. […] The need for regulatory work was identified both within JAA and EUROCONTROL."	EU	Presentation "Joint JAA/ EUROCONTROL Task-Force on UAVs" by Yves Morier
September 2003	EASA becomes operational	"Hitherto, certification was the responsibility of the [EU] Member States. In future, the Agency will issue certificates recognised EU-wide. [...] Ultimately, the Agency will develop its know-how in all areas of aviation safety to help the EU establish common rules for […] the approval of aviation activities…"	EU	http://europa.eu/rapid/press-release_IP-03-1333_en.htm (accessed 24-09-2018)
May 2004	Joint JAA/ EUROCONTROL Task Force publishes final report	"…address a development of a concept for the regulation of civil unmanned aerial vehicles (UAVs), with respect to safety, security, airworthiness (including continued airworthiness), operational approval, maintenance and licensing."	EU	Final Report – A Concept for European Regulations for Civil Unmanned Aerial Vehicles (UAVs)

[i] Unmanned Vehicle Systems International
[ii] European Aviation Safety Agency
[iii] Joint Aviation Authorities
[iv] European Organisation for the Safety of Air Navigation

(table continues on next page)

Date	Event	Content	Scope	Source(s)
		Phase 2: Regulatory Bricolage (2005-2010)		
January 2005	UAVnet[v]/CAPECON[vi]/ USICO[vii] publish action plan and strategic research agenda on UAV	"This proposal offers a unique opportunity to further unite and integrate Europe's aeronautics capabilities and develop a research and technological infrastructure to benefit society."	EU	25 Nations for an Aerospace Breakthrough, European Civil Unmanned Air Vehicle Roadmap
April 2005	ICAO[viii] initiative to discuss RPAS activities	"The first official discussion on RPAs was held at the first meeting of the 169th Session of ICAO Council on 12 April 2005. The Air Navigation Commission was requested a discussion on UAV operations in civil airspace."	Intl.	ICAO Assembly, 38th Session, Legal Commission (A38-WP/262)
November 2005	EASA publishes proposed policy for Unmanned Aerial Vehicle (UAV) certification	"The purpose of this Advance-Notice of Proposed Amendment (A-NPA) is to propose a policy for the certification of UAV (Unmanned Aerial Vehicle) Systems (the Policy) and is a first step towards more comprehensive UAV regulation."	EU	Advance-Notice of Proposed Amendment No. 16/2005 (A-NPA-16-2005)
December 2005	Publication of Rules for Model Airplanes (*Regeling Modelvliegen*)	"In this regulation, a model airplane means a small aircraft of which the total take-off mass does not exceed 25 kilograms."	NL	HDJZ/LUV/2005-2297
April 2006	Establishment EUROCAE[ix] Working Group 73 on UAS (WG-73)	"As the European UAS expert group, WG-73 will work with EASA in the development of airworthiness criteria and Special Conditions to supplement EASA A-NPA-16 Policy for Unmanned Aerial Vehicle (UAV) Certification."	EU	Presentation "Unmanned Aircraft Systems, EUROCAE Activities" by Daniel Hawkes (February 2008, Paris)
May 2006	First ICAO exploratory meeting on UAVs	"…to determine the potential role of ICAO in UAV regulatory development work. […] although there would eventually be a wide range of technical and performance specifications and standards, only a portion of those would need to become ICAO SARPs [Standards and Recommended Practices]. […] ICAO was not the most suitable body to lead the effort to develop such specifications. However, it was agreed that there was a need for harmonization of terms, strategies and principles with respect to the regulatory framework and that ICAO should act as a focal point."	Intl.	ICAO Cir 328, Unmanned Aircraft Systems (UAS)

[v] Civilian UAV Thematic Network: Technologies, Applications, Certification (EU funded initiative)
[vi] Civil UAV Applications and Economic Effectivity of Potential Configuration Solutions (EU funded initiative)
[vii] UAV Safety Issues for Civil Operations (EU funded initiative)
[viii] International Civil Aviation Organization
[ix] European Organisation for Civil Aviation Equipment

(table continues on next page)

Date	Event	Content	Scope	Source(s)
January 2007	Second ICAO informal meeting on UAVs that led to establishment of UASSG[x]	Decision by ICAO for "study group be formed to assist the Secretariat in developing a framework for regulatory development, guiding the SARPs development process within ICAO, and to support a safe, secure and efficient integration of UAS into non-segregated airspace."	Intl.	ICAO UAS Study Group
February 2007	Establishment of SESAR[xi] Joint Undertaking	"The aim of the Joint Undertaking is to ensure the modernisation of the European air traffic management system by federating research & development efforts in the Community."	EU	https://ec.europa.eu/transport/modes/air/sesar/sesar_undertaking_en (accessed 26-09-2018)
October 2007	Founding INOUI[xii] Consortium	"The project INOUI focuses on the integration of Unmanned Aircraft Systems (UAS) in non-segregated airspace. […] INOUI represents a holistic approach to UAS integration. Goal of INOUI is to provide a stepwise approach to enable the earliest possible use of UAS applications."	EU	INnovative Operational UAS Integration, Proposal for the Integration of UAS into non-segregated Airspace
December 2007	EASA publishes Common Response Document on "Policy for Unmanned Aerial Vehicle (UAV) certification"	Extensive 270 pages document with detailed responses from EASA to all comments received during the public consultation period between Nov. 2005 and Feb. 2006.	EU	CRD to A-NPA-16-2005
January 2008	European Commission publishes study analysing the current activities in the field of UAV	"Where are we today – the industrial/economical/political situation in Europe and the international interdependencies. […] What vision can be drawn for Europe in this technology domain and what needs to be done to make it happen."	EU	Study analysing the current activities in the field of UAV (first and second element), ENTR/2007/065
February 2008	Establishment JARUS[xiii] (first meeting)	"JARUS' first meeting took place […] and began with just a handful of member states."	Intl.	JARUS press release
February 2008	EASA Basic Regulation	Decision by the European Parliament and the Council of the European Union to refine the competencies of EASA (in addition to (EC) No. 1592/2002 from July 2002).	EU	(EC) No. 216/2008

[x] Unmanned Aircraft System Study Group
[xi] Single European Sky ATM Research
[xii] INnovative Operational UAV Integration
[xiii] Joint Authorities for Rulemaking on Unmanned Systems

(table continues on next page)

Date	Event	Content	Scope	Source(s)
April 2008	UASSG becomes operational (first meeting)	"…assembled to embark on legislative efforts toward international cooperation, the development of regulation and manuals, technical specifications and the Standards and Recommended Practices (SARPs)."	Intl.	Unmanned Aircraft Systems Study Group (UASSG), First Meeting (UASSG/1-SD) ICAO Assembly, 38th Session, Legal Commission (A38-WP/262)
August 2009	EASA publishes general principles for type certification of UAS	"This policy shall be used by the Agency's staff when certificating UAS. […] The policy represents a first step in the development of comprehensive civil UAS regulation."	EU	Rulemaking Directorate Policy Statement, Airworthiness Certification of Unmanned Aircraft Systems (UAS), E.Y013-01
October 2009	EC DG MOVE[xiv] first hearing on unmanned aircraft (<150 kg)	"To understand the current European Light UAS industrial base and the current Light UAS applications in Europe; to identify potential obstacles, enablers and best practices in Europe; to exchange directly with the European Light UAS community views and assess the future potential role of EC for the insertion of Light UAS."	EU	Hearing on Light Unmanned Aircraft Systems (UAS)
April 2010	INOUI Consortium publishes final report	"Main objective of the INOUI project was to provide a roadmap to the future of UAS in the context of the ever changing ATM [Air Traffic Management] environment."	EU	INOUI, Final Activity Report
July 2010	European Commission & European Defence Agency organize European High Level Unmanned Aircraft Systems (UAS) Conference	"…where approximately 450 participants from around the world discussed issues such as how RPAS can support European policies, the different uses of RPAS, and the institutional and infrastructure aspects, which would have to be addressed to allow RPAS to fly in non-segregated airspace."	EU	RPAS – The European Approach & The Way Forward https://ec.europa.eu/transport/modes/air/event/conference-uas-unmanned-air-systems_en (accessed 25-09-2018)

(table continues on next page)

[xiv] The European Commission's Directorate-General for Mobility and Transport

Date	Event	Content	Scope	Source(s)
		Phase 3: Focused Efforts (2011-2015)		
March 2011	ICAO publishes formal report on unmanned aircrafts	"The goal of ICAO in addressing unmanned aviation is to provide the fundamental international regulatory framework through Standards and Recommended Practices (SARPs), with supporting Procedures for Air Navigation Services (PANS) and guidance material, to underpin routine operation of UAS throughout the world in a safe, harmonized and seamless manner comparable to that of manned operations. This circular is the first step in reaching that goal."	Intl.	ICAO Circular 328-AN/190
June 2011	European Commission launches UAS Panel (series of five workshops)	"…an imitative to explore the current competitive situation for Unmanned Aircraft Systems (UAS) globally and to identify the key challenges and obstacles which need to be addressed to assist the development and operation of the UAS sector in Europe."	EU	European Commission Unmanned Aircraft System Panel Process, Report on Workshop
May 2012	Establishment EUROCAE Working Group 93 on Light RPAS (WG-93)	"Develop standards and recommendations for guidance material for the safe operation of Light RPAS, sequenced in order of priority for the Light RPAS community, with output primarily directed towards regulator. […] Guided by regulators needs and approval oversight such as EASA, JARUS, NAAs [National Aviation Authorities]."	EU	Presentation "EUROCAE RPAS Activities" by unknown
June 2012	Establishment of ULTRA[xv] Consortium	"To provide a comprehensive set of recommendations for the incremental insertion of civil Light RPAS (those with an operating mass of up to 150 kg) in the European airspace in the short-term (i.e. within 5 years from now); to provide specific recommendations for selected 'Use Cases' to be explored as 'quick win' business cases; highlight what needs to be done in order to unlock the full potential of the civil Light RPAS market in the long-term (i.e. 10-15 years from now)."	EU	https://ultraconsortium.eu/about-us/ (accessed 26-09-2018)
July 2012	Establishment of European RPAS Steering Group	"…set up by the European Commission … on the future of RPAS in Europe. The European RPAS Steering Group received the mandate to establish a roadmap for the safe integration of civil RAS into the European aviation system, aiming at an initial RPAS integration by 2016."	EU	https://uvs-international.org/european-matters/european-rpas-roadmap-2013/ (accessed 25-09-2018)

(table continues on next page)

[xv] Unmanned Aerial Systems in European Airspace

Date	Event	Content	Scope	Source(s)
August 2012	EASA publishes proposed alignment of the European Common Rules of the Air	"the present NPA includes five major aspects: the certification of the remotely piloted aircraft system (RPAS), including the airworthiness of the remotely piloted aircraft (RPA); the certification of RPAS operators involved in commercial air transport and/or specialised operations (SPO); the licensing of remote pilots; provisions to facilitate the 'special authorisation' mandated by Article 8 of the Chicago Convention for international RPAS operations…"	EU	Notice of Proposed Amendment (NPA) 2012-10, Transposition of Amendment 43 to Annex 2 to the Chicago Convention on remotely piloted aircraft systems (RPASs) into common rules of the air
September 2012	European Commission publishes strategy working document	"To reap the full benefits of this new technology for growth and jobs, Europe should remove, in a coordinated way, the existing barriers and support the internal market for civil RPAS services."	EU	European Commission, Staff Working Document SWD(2012)259, Towards a European strategy for the development of civil applications of Remotely Piloted Aircraft Systems (RPAS)
November 2012	Founding of Dutch industry association DARPAS[xiv]	"Dutch trade association for professional production and use of unmanned aircraft systems (also called drones, RPAS, UAS or UAV). […] The aim of the association is to represent the interests of members who are engaged in the research and development, production, use, services and applications of RPAS (drones) in the Netherlands."	NL	http://www.darpas.nl/ (accessed 25-09-2018)
June 2013	Revision of rules for model airplanes (*Regeling Modelvliegen*)	Changes allow to distinguish between recreational and professional use; include general prohibition of use unmanned aircraft up to 150 kg; include prohibition for commercial use model aircraft up to 25 kg (applying for an exemption is possible).	NL	Presentation "Drones, Ontwikkelingen regelgeving in Nederland" by Hanneke van Traa-Engelman
June 2013	European RPAS Steering Group publishes final report	"By presenting a clear way forward towards the integration of RPAS, the Roadmap is expected to facilitate the decisions to be taken by the different organisations involved, provide transparency and efficiency in the planning of different initiatives and support the coordination of the related activities in Europe. […] The complete document includes 3 annexes entitled: A Regulatory Approach; A Strategic Research Plan; A Study on the Societal Impact"	EU	Roadmap for the integration of civil Remotely-Piloted Aircraft Systems into the European Aviation System, Final report from the European RPAS Steering Group

(table continues on next page)

[xiv] Dutch Association for Remotely Piloted Aircraft Systems

Date	Event	Content	Scope	Source(s)
December 2013	ULTRA Consortium publishes final report	"Analyse current and past work relative to civil RPAS […] and propose a starting point for Light RPAS operations in the short-term. […] Develop a business model for civil Light RPAS applications. […] Perform an in-depth analysis on how to overcome the barriers and mistrust of (Light) RPAS by the general public. […] Foster the European innovation in terms of aviation automation and provide a path which facilitates access to market for European SMEs. […] Develop recommendations to support a sustainable civil Light RPAS market in the short-term and to highlight the actions needed in order to unlock the full potential of the (Light) RPAS market in the long-term."	EU	ULTRA, Unmanned Aerial Systems in European Airspace, Project Full Final Report https://ultraconsortium.eu/about-us/ (accessed 26-09-2018)
March 2014	Dutch Ministry of Justice and Security makes action plan for unmanned vehicles	"The purpose of this research is to gain insight into the implications the use of drones has for legislation and policy. What are the expected possibilities and threats stemming from the use of drones, to what extent does the current legal framework offer room for these possibilities and provides measures against these threats […]?"	NL	Tweede Kamer der Staten-Generaal, attachment to Kamerstuk 30 806 (No. 21)
May 2014	ICAO replaces UASSG with RPAS Panel	"…serve as the focal point and coordinator of all ICAO RPAS related work, with the aim of ensuring global interoperability and harmonization; develop an RPAS regulatory concept and associated guidance material to support and guide the regulatory process…"	Intl.	Presentation "ICAO RPAS Panel, Working Group 1 – Airworthiness" by Stephen George & Bruno Moitre
December 2014	First Dutch lawsuit against journalist	Journalist was fined 500 Euro for making recordings in the vicinity of Rotterdam-The Hague Airport with his drone. According to the aviation police, the drone was a danger to the airports' flight path.	NL	https://nos.nl/artikel/2008469-eerste-drones-rechtszaak-tegen-journalist.html (accessed 01-10-2018)
March 2015	Riga Declaration	"The European aviation community gathered in Riga to exchange views on how, and under which conditions, drones can help create promising new opportunities in Europe, offering sustainable jobs and new prospects for growth both for the manufacturing industry and for future users of drones in all sectors of society. […] Five essential principles for future EU focus: RPAS need to be treated as new types of aircraft with proportionate rules based on the risk of each operation; EU rules for the safe provision of RPAS services need to be developed to enable the industry to invest; Technology and standards need to be developed to enable full integration of RPAS into European airspace; Public acceptance is key to the growth of RPAS services; The operator of an RPAS shall be responsible for its use."	EU	Riga Declaration on Remotely Piloted Aircraft (drone), "Framing the Future of Aviation" Report on the safe use of remotely piloted aircraft systems (RPAS), commonly known as unmanned aerial vehicles (UAVs), in the field of civil aviation, A8-0261/2015

(table continues on next page)

Date	Event	Content	Scope	Source(s)
March 2015	ICAO publishes RPAS Manual	"This manual addresses RPAS as one subset of UAS. RPAS are envisioned to be an equal partner in the civil aviation system, able to interact with air traffic control (ATC) and other aircraft on a real-time basis. The scope of ICAO provisions in the next 5 to 10 years is to facilitate integration of RPAS operating in accordance with instrument flight rules (IFR) in controlled airspace and at controlled aerodromes."	Intl.	ICAO, Manual on Remotely Piloted Aircraft Systems (RPAS), Doc 10019, AN/507
March 2015	EASA publishes concept of operations for drones	"Considering the broad range of operations and types of drones, it is proposed to establish three categories of operations and their associated regulatory regime: Open, Specific and Certified. […] Harmonisation of drones rules are a must which is recognised by all parties. This concept for a regulatory framework will be proposed to JARUS and ICAO as the European input thus contributing to global harmonisation."	EU	EASA, Concept of Operations for Drones - A risk based approach to regulation of unmanned aircraft
March 2015	EASA publishes policy initiative	"…update Regulation (EC) No. 216/2008 (the EASA Basic Regulation) in order to make it best respond to changes in the aviation environment and subsequent challenges to its safety."	EU	EASA Opinion No. 01/2015, European Commission policy initiative on aviation safety and a possible revision of Regulation (EC) No. 216/2008
May 2015	Working Conference on Drones (*Kabinetsstandpunt Drones*)	"…the Dutch Ministries of Safety & Justice, Infrastructure & Environment, and Economic Affairs, organised a working conference relative to a recently published joint report reflecting the cabinet's view on RPAS. The purpose of this event was to comment the report, and with inputs of the attendees, prepare the way ahead. The event, which was attended by 150 Dutch policy makers and industry & research representatives, […] a few days prior to the first Dutch RPAS regulation coming into force."	NL	UVS International, Background & Activities, 1998-2015
June 2015	ISO[xiv] launches Technical Subcommittee 16 on UAS	"Develops international standards in the field of unmanned aircraft systems (UAS) including, but not limited to classification, design, manufacture, operation (including maintenance) and safety management of UAS operations."	Intl.	ISO/TC 20/SC 16, Unmanned aircraft systems

(table continues on next page)

[xiv] International Organization for Standardization

Date	Event	Content	Scope	Source(s)
July 2015	First publication of rules for commercial use of drones (*Regeling op Afstand Bestuurde Luchtvaartuigen*) and revision of rules for model airplanes (*Regeling Modelvliegen*)	Commercial use of drones does not require applying for an exemption anymore. However, rules are similar to recreational use and a RPAS Operator Certificate (ROC) is needed. The rules for the recreational use of drones were also tightened.	NL	Ministerie van Veiligheid en Justitie, Letter "Nadere uitwerking kabinetsstandpunt drones", 661936, August 2015
July 2015	EASA publishes introduction of a regulatory framework for the operation of drones (based on principles of Riga Declaration)	"It follows a risk- and performance-based approach; it is progressive- and operation-centric. It introduces three categories of operations as already proposed in the published EASA Concept of Operations for Drones: 'Open' category (low risk); […] 'Specific operation' category (medium risk); […] 'Certified' category (higher risk). […] This regulatory framework will encompass European rules for all drones in all weight classes."	EU	Advance-Notice of Proposed Amendment, A-NPA 2015-10
September 2015	European Parliament publishes report on safe drone use	"…supports the Commission's intention to remove the 150kg threshold and to replace it with a coherent and comprehensive EU regulatory framework that would allow national competent authorities, qualified bodies or associations to assume validation and oversight activities; considers that the proportionality of the rules should be complemented by the necessary flexibility in processes and procedures."	EU	Report on the safe use of remotely piloted aircraft systems (RPAS), commonly known as unmanned aerial vehicles (UAVs), in the field of civil aviation, A8-0261/2015
October 2015	Establishment of DroneRules project	"…aims at building a comprehensive and high quality online presence in order to create THE reference web portal in the European Union (EU) (+ Norway and Switzerland) with the purpose of increasing awareness and facilitating understanding of the legal environment and constraints in relation with light RPAS operations (safety, privacy and data protection, insurance, etc.), and with a focus on non-commercial operators (incl. hobbyists)."	EU	UVS International, Background & Activities, 1998-2015 http://dronerules.eu/ (accessed on 01-10-2018)
September 2015	General Consultation by the Dutch House of Representatives	The standing committee for Security and Justice, the standing committee for Economic Affairs and the standing committee for Infrastructure and the Environment consulted Minister of Security and Justice and Secretary of State of Infrastructure and Environment on drone issues.	NL	Tweede Kamer der Staten-Generaal, Algemeen Overleg, Kamerstuk 30 806 (No. 31), Onbemande vliegtuigen (UAV)

(table continues on next page)

Date	Event	Content	Scope	Source(s)
December 2015	JARUS establishes Stakeholders Consultation Body (SCB)	"…a self-governing association of aviation industry organizations, established to provide expertise and advice. […] SCB representatives and alternates represent diverse and evolving Communities of Interest and represent all sectors of the aviation industry. The SCB acts as a forum of stakeholder interests to enable their views to be represented and discussed in an open and constructive manner to facilitate the establishment of balanced and consolidated JARUS deliverables."	Intl.	UVS International, Background & Activities, 1998-2015 http://jarus-rpas.org/stakeholders-consultation-body (accessed on 01-10-2018)
December 2015	EASA publishes technical Opinion	"…27 concrete proposals for a regulatory framework and for low-risk operations of all unmanned aircraft irrespective of their maximum certified take-off mass…"	EU	EASA Technical Opinion, Introduction of a regulatory framework for the operation of unmanned aircraft
December 2015	European Commission publishes comprehensive strategy for the European aviation sector	"…as part of the European Commission's Aviation Strategy to Enhance the Competiveness of the EU Aviation Sector, the European Commission adopted a new Aviation Strategy. This Aviation Strategy proposal consisted of two documents: communication on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and repaling Regulation (EC) No 216/2008 of the European Parliament and of the Council (23 pages); Annexes 1 to 10 (Annex IX addresses 'Essential Requirements for Unmanned Aircraft'."	EU	UVS International, Background & Activities, 1998-2015
		Phase 4: Working Towards Harmonization (2016-2018)		
May 2016	Publication of Mini Drone Regulation (*Mini Drone Regeling*)	Regulation to reduce the rules for RPAS of no more than 4 kg.	NL	Presentation "Drones, Ontwikkelingen regelgeving in Nederland" by Hanneke van Traa-Engelman
September 2016	EUROCAE creates Working Group 105 on Unmanned Aircraft Systems (UAS) by merging Working Groups 73 & 93	"The task of WG-105 is to develop the necessary standards to allow the safe integration of all types of UAS into all types of airspace under all conditions and for each type of operation…"	EU	EUROCAE Broadcast, Edition 6/2017, Message from the Secretary General

(table continues on next page)

Date	Event	Content	Scope	Source(s)
October 2016	SESAR Joint Undertaking publishes drone demonstration project results	"Over ten years ago drones or remotely-piloted aircraft systems (RPAS) were not part of the SESAR Definition Phase as it was impossible to predict at that time the exponential growth of these unmanned aircraft. Over time, however, it became clear that if safe, non-segregated, unmanned operations were ever to become commonplace, it would be essential for the SESAR Joint Undertaking (JU) to adapt its research and innovation to developments in this field. It would also require the partnership to show leadership in the air traffic management (ATM) domain, taking advantage of the comprehensive SESAR membership to ensure a coordinated approach to European drone integration."	EU	Demonstrating RPAS integration in the European aviation system
November 2016	SESAR Joint Undertaking publishes study on economic potential of EU drone market	"Stimulating economic benefits and job opportunities for Europe will require many urgent actions to address the remaining gaps in technology and regulation. […]To take a global leadership position, fast implementation of a comprehensive EU 'drone package' is required to establish a single drone market."	EU	European Drones Outlook Study, Unlocking the value for Europe
February 2017	EUROCONTROL publishes RPAS Air Traffic Management concept of operations	"…describes the operations of RPAS in European Airspace that are capable of meeting the requirements set per airspace classification including Very Low Level (VLL) operations. The CONOPS [Concept of Operations] is presented from an air traffic management (ATM) perspective…"	EU	EUROCONTROL, RPAS ATM CONOPS
May 2017	EASA publishes proposed operation of drones in the 'open' and 'specific' categories	"…the regulation of unmanned aircraft systems (UAS) with a maximum take-off mass (MTOM) of less than 150 kg falls within the competence of the European Union (EU) Member States (MSs). This leads to a fragmented regulatory system hampering the development of a single EU market for UAS and cross-border UAS operations. A new proposed Basic Regulation […] aims to solve this issue, by extending the competence of the EU to regulate all UAS regardless of their MTOM. In view of the adoption of this new Regulation, the objective of this Notice of Proposed Amendment (NPA) 2017-05 is: to ensure an operation-centric, proportionate, risk- and performance-based regulatory framework for all UAS operations conducted in the open and specific category; to ensure a high and uniform level of safety for UAS; to foster the development of the UAS market; and to contribute to enhancing privacy, data protection, and security."	EU	Notice of Proposed Amendment, NPA 2017-05 (A) & (B)

(table continues on next page)

Date	Event	Content	Scope	Source(s)
June 2017	Establishment EUSCG[xviii]	"The EUSCG is a joint coordination and advisory group established to coordinate the UAS-related standardisation activities across Europe, essentially stemming from the EU regulations and EASA rulemaking initiatives. The EUSCG provides a link to bridge the European activities to those at international level."	EU	https://www.eurocae.net/about-us/euscg/ (accessed 27-09-2018)
October 2017	ICAO publishes preliminary version RPAS concept of operations	"This concept of operations (CONOPS) aims to describe the operational environment of manned and unmanned aircraft thereby ensuring a common understanding of the challenges and how the subset that are remotely piloted can be expected to be accommodated and ultimately integrated into the airspace for international instrument flight rules (IFR) operations."	Intl.	Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations
November 2017	Helsinki Declaration	"…called for clear and simple rules that keep the burden for citizens, operators and authorities as light as possible, and that lower the threshold for entering the EU drone services…"	EU	Drones Helsinki Declaration
January 2018	ACI[xix] Europe publishes position paper	"Letting drones into European airports is a complex but feasible endeavour. Necessary adaptations would include ATC [Air Traffic Control] technology & procedures, airport infrastructure & technology and procedures, as well as operator technical & operational profiles."	EU	ACI Europe Position on Drone Technology
February 2018	EASA publishes first formal Opinion on safe operations for small drones in Europe (Outcome of A-NPA 2015-10)	"The objective of this Opinion is to create a new regulatory framework that defines measures to mitigate the risk of operations in the 'open' category […] and 'specific' category. […] The proposed regulations will provide flexibility to Member States (MSs), mainly by allowing them to create zones within their territories where the use of UAS would be prohibited, limited or, in contrast, facilitated."	EU	EASA, Opinion No. 01/2018, Introduction of a Regulatory Framework for the Operation of UAS in the "Open" & "Specific" Categories
February 2018	SESAR Joint Undertaking publishes roadmap for drone integration into airspace	"This proposed contribution to the update of the European ATM [Air Traffic Management] Master Plan is an important milestone on that path. It provides a bold vision for the safe integration of drones into all classes of airspace and an ambitious rollout plan, ensuring that the energy of our community is channelled towards clear priorities."	EU	SESAR Joint Undertaking, European ATM Master Plan: Roadmap for the Safe Integration of Drones into all Classes of Airspace

[xviii] European UAS Standards Coordination Group
[xix] Airports Council International

(table continues on next page)

Date	Event	Content	Scope	Source(s)
March 2018	Hearing/roundtable discussion by Dutch House of Representatives	Organized by the standing committee for Infrastructure and Water Management to get information on the opportunities and problems of the use of drones by professionals and others.	NL	https://www.tweedekamer.nl/debat_en_vergadering/commissievergaderingen/details?id=2018A00461 (accessed 26-09-2018)
May 2018	International Transport Forum of the OECD[xx] publishes report on drones in transportation	"This report investigates the role of drones as part of the future transport mix. It specifically addresses the issues policy makers face in engaging with the emerging private drone sector. […] With the sector developing at a rapid pace, regulators will want to create frameworks for drone use that allow innovation while ensuring positive overall outcomes."	Intl.	(Un)certain Skies? Drones in the World of Tomorrow
June 2018	EU adopts new Basic Regulation for aviation	"…updated aviation safety rules, which include a revised mandate for the European Aviation Safety Agency (EASA) and the first ever EU-wide rules for civil drones of all sizes."	EU	https://www.uasvision.com/2018/07/03/europe-adopts-new-basic-regulation-for-aviation/ (accessed 26-09-2018) (EU) 2018/1139

Please note: In this table, we stayed close to the original terminology used in the sources included. The terms UAV (Unmanned Aircraft Vehicle), UAS (Unmanned Aircraft System) and RPAS (Remotely Piloted Aircraft System) can be used interchangeably. We also refer to 'drones' as overarching term.

Table 3.6 Timeline of Events RPAS Industry

[xx] Organisation for Economic Co-operation and Development

In what follows, we outline the way in which interactions play out when entrepreneurs and regulators are faced with the joint task of creating an effective regulatory context (Table 3.7 presents an overview of these interactions), and illustrate how they shape certain phases in the process of proto-institutional emergence (Figure 3.1 provides a visual illustration of the model). Additionally, we highlight which proto-institutions had emerged at the point where the institutional frictions endemic to those proto-institutions sounded in a transitional moment proceeding from one evolutionary phase into the next. We also document the nature of these institutional frictions themselves (see Table 3.8).

Perception Entrepreneur	Enactment Entrepreneur	Response Regulator	Enactment Regulator	
Rules Apply	Enabling	Constraining	Compliance through Rule Reinforcement	→ Playing by the Increasingly Clearer Rules
Rules Apply	Constraining	Facilitating	Co-creation through Rule Selection	→ Working on Better Regulation
Rules Do Not Apply	Disregarding	Constraining	Compliance through Rule Proliferation	→ Why Care about the Rules?
Rules Do Not Apply	Exception	Facilitating	Co-creation through Rule Refinement	→ Changes in Regulation Needed

Table 3.7 Entrepreneur-Regulator Interactions

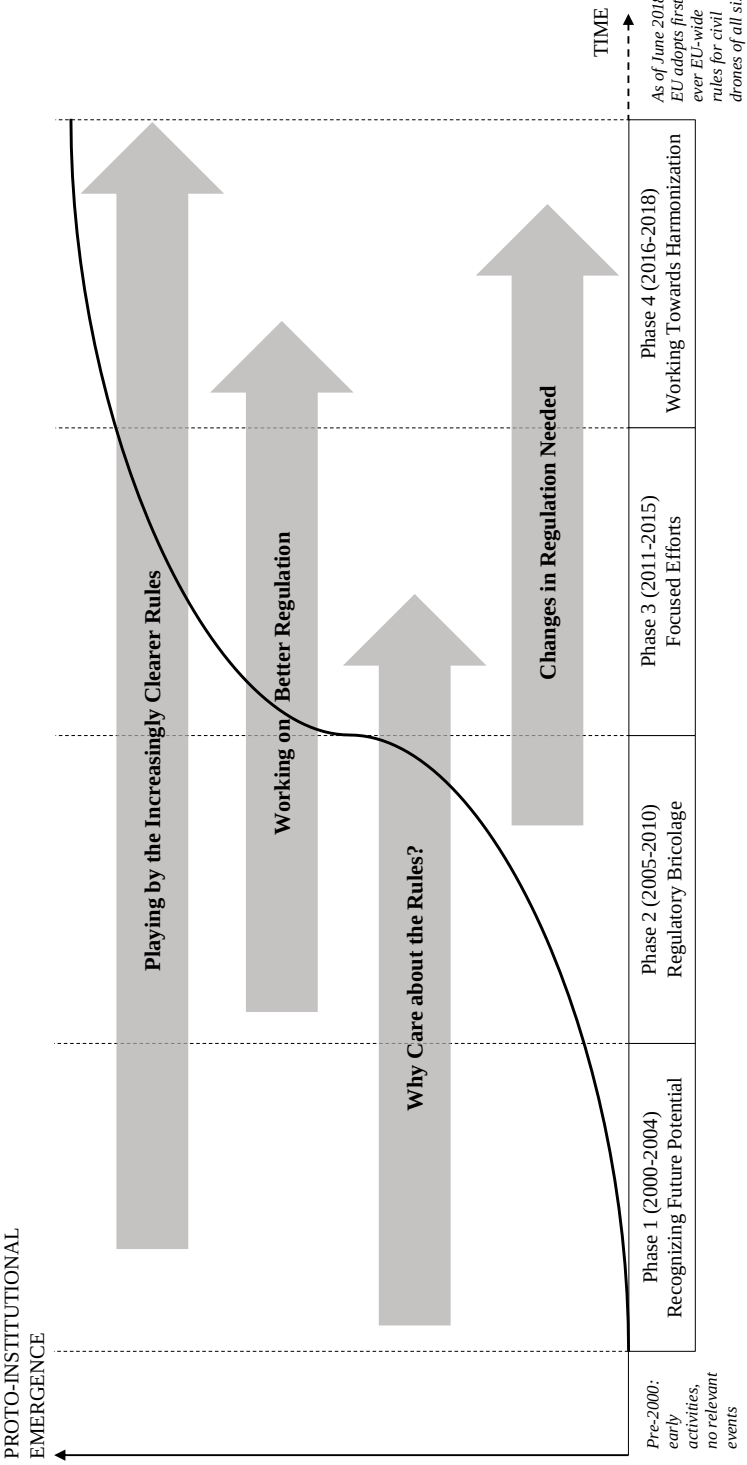

Figure 3.1 Process Model of Proto-Institutional Emergence

	Emerging Proto-Institution	Institutional Friction
Phase 1 (2000-2004) **Recognizing Future Potential**	Entrepreneurs that disregard existing frameworks are faced with constraining responses by regulators (*Why Care about the Rules?*), while regulators enforce compliance from entrepreneurs that view current situation as enabling (*Playing by the Increasingly Clearer Rules*). RPAS emerged as a new civil market category, and became an object of interest for previously unconcerned governmental bodies and industry initiatives.	Increasingly, after the RPAS industry emerged as a cognitive category, the need to engage in concrete regulatory future actions was felt by all industry actors.
transition		
Phase 2 (2005-2010) **Regulatory Bricolage**	While interactions between entrepreneurs and regulators from the previous phase continue, both parties start engaging in co-creation activities: rule selection occurs when entrepreneurs are constraint in developing promising new business models (*Working on Better Regulation*), while regulators also make exceptions for other cases in which refinement is needed (*Changes in Regulation Needed*). Attempts on all levels, national to international, to propose policy guidance frameworks while entrepreneurial initiatives continue to grow.	Gradually, industry actors are faced with a plethora of disconnected regulation and recognize that further coordination and structuration is required.
transition		
Phase 3 (2011-2015) **Focused Efforts**	While most interactions between entrepreneurs and regulators from the previous phase continue, interactions between rule-disregarding entrepreneurs that evoke constraining regulator responses (*Why Care about the Rules?*) phase out. Standardization efforts intensify as recommended practices, guidance material, suggested standards and certification structures emerge; rule-making bodies acknowledge and reference each other's work.	Progressively, although regulatory instructions are beginning to become more focused, industry actors experience the limitations of not having established binding and collective rules yet.
transition		
Phase 4 (2016-2018) **Working Towards Harmonization**	Two of the remaining interactions are slowly phasing out (*Working on Better Regulation; Changes in Regulation Needed)* as the development reaches harmonization, and agreement is reached broadly on all levels and between most stakeholders. Rule reinforcement by regulators and acceptance by entrepreneurs continue to be dominant until the end (*Playing by the Increasingly Clearer Rules).* Increasing clarity and common agreement on how RPAS should be understood, how they should be dealt with systematically, and how this should be reinforced appropriately and in a unified manner.	

Table 3.8 Transitional Characteristics of Emerging Proto-Institutional Arrangements

3.4.2.1 Phase 1 (2000 - 2004): Recognizing Future Potential

Before 2000, only limited activities were connected to RPAS. From the turn of the millennium onwards, however, several relevant events took place on a European scale, such as the foundation of the first European industry association for RPAS in 2000 (UVS International), and the organization of a first EU-funded awareness-raising workshop in 2001. In 2002, the establishment of the European Aviation Safety Agency, EASA, followed. In the same year, the European Commission recognized and mentioned RPAS for the first in the general strategic aerospace policy framework, and a taskforce was formed between the Joint Aviation Authorities (JAA) and European Organisation for the Safety of Air Navigation (EUROCONTROL). EASA officially became operational in 2003, taking up its mandate for RPAS certification in Europe, initially for systems of more than 150 kilograms. In an attempt to develop an early concept of RPAS regulation, the JAA/EUROCONTROL task force published their final report in 2004.

Typical for this period is a type of entrepreneur-regulator interaction in which regulators seek to enforce compliance from entrepreneurs, while the latter see the regulatory environment as mostly enabling (*Playing by the Increasingly Clearer Rules*). This interaction creates a regulatory context in which regulators seek to set certain baseline rules, which are affirmed by entrepreneurs by adjusting their behavior to these rules. When reflecting on the circumstances in which RPAS businesses operate, we found a number of entrepreneurs who recognized that the rules in place apply to their businesses. According to Respondent 14, who worked for the Dutch police before starting his own firm, following the rules means that "you have to read [current rules] carefully and comply with them. It's really as simple as that." To the extent that regulations stemming from general aviation laws are already in place during this early phase of *Recognizing Future Potential*, entrepreneurs with a background in manned aviation seemed to profit from their in-depth knowledge in this area, allowing them to interpret these rules as enabling

structures. Respondent 13, with a background in manned aviation, remembered that "in the beginning, I had to read a lot to get an understanding about how it all works. For me it's easy, because 90 percent of it is a copy of manned aviation [law]. That's what I know already."

In contrast to the belief that current rules apply to their company, another group of entrepreneurs operates on the belief that rules do not apply to them, which evoked a more restrictive regulatory response (*Why Care about the Rules?*). This interaction is built on a disregard of the given regulatory context, causing regulators to create new and more restrictive rules to constrain entrepreneurs portraying a careless attitude to extant regulatory frameworks. Some entrepreneurs knowingly disregarded the rules in place, especially during the early stages of the *Recognizing Future Potential* phase, when flying RPAS was not as common as in later phases, and when the consequences for non-compliance were usually limited. Effective policing was not in place at that time and it was often unclear what constituted illegal activities (personal communication). Especially entrepreneurs who are part of the RPAS industry, but do not operate unmanned aircraft themselves (e.g., they offer consultancy and related products/services), felt that rules do not apply to them and can thus safely be disregarded. As Respondent 1 put it, "my company is purely doing consultancy work. And interim project leadership for different kind of projects. I do not fly [a drone] myself." These entrepreneurs are indifferent to many rules, as they do not directly facilitate or constrain their entrepreneurial activities. However, while rules do not apply to them directly, this does not mean that these entrepreneurs remain totally unaffected by regulations. Respondent 4 developed a mobile application that makes it possible for RPAS operators to register their upcoming flights, to see who is flying at a certain location, and to check whether they are currently operating in a no-fly zone. For that reason, he believed that the current rules do not apply to his firm and would not affect him greatly: "It is just the way that it will be and I will adjust my app [mobile phone application] accordingly".

This group of entrepreneurs does not receive much attention from rule-makers, and does not necessarily seek to interact with them.

In sum, in this first phase the EU and related parties recognized that RPAS were an upcoming phenomenon in civil markets. Previously unconcerned governmental bodies and industry initiatives became aware of RPAS' implications for general aviation operations. While entrepreneurs showed both rule following and rule avoiding behavior, regulators enforced compliance through rule proliferation and reinforcement. However, all actors increasingly experienced the institutional frictions stemming from lacking future-oriented regulatory actions, which contributed to the transition to the second phase.

3.4.2.2 Phase 2 (2005 - 2010): Regulatory Bricolage

RPAS activities were brought to international attention in 2005, when the Air Navigation Commission of ICAO requested their discussion. This was followed the next year with ICAO's first exploratory meeting on the issue and a second meeting in 2007 that led to the establishment of a dedicated study group (UASSG) to look into the development of regulatory frameworks. UASSG became operational in 2008 and during the same year, JARUS was also put in place with the same objective. On European scale, a number of advisory documents were published in this phase. A consortium formed by UAVnet (Civilian UAV Thematic Network), CAPECON (Civil UAV Applications and Economic Effectivity of Potential Configuration Solutions) and USICO (UAV Safety Issues for Civil Operations) proposed a strategic agenda and action plan in 2005, while EASA proposed a RPAS certification policy. Two years later, the Agency published a response document covering 270 pages of comments and detailed responses to the earlier proposed certification policy draft. In 2008, the European Commission issued their first study analyzing current RPAS activities and detailing their future vision of the field. The same year, the European Parliament and the Council of the European Union decided to grant EASA more competency in aviation rule-making (often referred to as Basic

Regulation), which was followed by the publication of general RPAS type certification principles in 2009. Also, a number of new consortia and working groups emerged EU-wide, such as the EUROCAE working group on RPAS to develop certification and standards in 2006. The following year, SESAR (Single European Sky ATM Research) Joint Undertaking was formed to provide guidance to the European air traffic management system concerning RPAS integration issues. Also in 2007, the INOUI (INnovative Operational UAV Integration) Consortium was formed to focus on the integration of RPAS into airspace more generally, which was followed by the publication of the consortium's final report in 2010. Next to the working groups and reports, personal exchanges were facilitated through the European Commission's Directorate-General for Mobility Transport's first hearing on RPAS in 2009, while the European Commission organized a RPAS conference together with the European Defence Agency in 2010. In the Netherlands, the first rules for model airplanes were published in 2005, aimed at regulating small unmanned aircraft with a weight of less than 25 kilograms. This was the first step taken by the Netherlands to regulate behaviors concerning RPAS.

With the number of initiatives on the increase and with additional rule-making attempts underway, another distinct entrepreneur-regulator interaction type emerged, with entrepreneurs acknowledging the existence and applicability of rules and regulations, but also perceiving these as being restrictive. To promote industry development, regulators responded by trying to make rules and regulations more facilitative (*Working on Better Regulation*). Specifically, regulators consulted with entrepreneurs to identify which rules worked and to eliminate the ones that did not, such as the ones perceived by entrepreneurs as unnecessarily restrictive. Both parties were thus working in concert to create better regulations. Respondent 17 runs a company that uses RPAS for aerial filming and photographing. He felt that "the rules are not even that clear, there are a number of them that are enormously binding and restricting." Others agreed that the regulation "is very unclear at the moment in

the Netherlands and it is also [the country] where you are allowed the least in the commercial setting" (Respondent 27). These sentiments were widespread in this phase of *Regulatory Bricolage*, when the first RPAS-specific rules were published. When rule makers found that there was a large group of stakeholders who believed the current situation to be untenable, they showed their willingness to continue with a sub-set of rules and regulations that were more practical to use. While "legislation is a prerequisite that can be quite restrictive", rule makers realized that "it also offers opportunities, so that with a collaboration between the government and the industry you have to see how at one point we can get innovation off the ground" (Respondent 24).

While entrepreneurs continued to adhere to rules that they perceived as applicable to their businesses (*Playing by the Increasingly Clearer Rules*), rules still had to be made more accessible, especially during the early phase of *Regulatory Bricolage* when little was communicated in a tailored way to the general public. This required a mutual willingness to invest extra effort into understanding the current situation, reading through legislative texts and/or getting involved with other industry stakeholders and regulatory institutions. However, this group of entrepreneurs also saw the extant rules as enabling, making it possible for their businesses to sustain and enhance their operations. The owner of an aerial inspection company elucidated this point:

> *To us, current regulation is a fact. We have to deal with it. We have very limited influence on it. We may be able to change a few things about the conditions in the Netherlands, but we don't have any influence at all on what's happening in England or Germany. (...) Many people say: the regulations need to be better. But it's all very clear. Those rules are still as clear as they can be. (...) This week I was asked to sign a petition against the new regulations. I replied: no, because I am pleased with the new rules, which really annoyed some people.* (Respondent 12).

We also observed ongoing interactions between rule-disregarding entrepreneurs and constraining regulators in this phase (*Why Care about the Rules?*).

Reflecting on the state in the Netherlands, Respondent 19 (who also manufactures his own RPAS) remained convinced that "if you want to create an operational [RPAS] system here, you will need to do things that are not allowed". Respondent 22 agreed with this perspective and stated that after the first regulations came into place in the Netherlands, he continued to operate "illegally" to be able to keep his air photography business alive:

> *…legislation changed in such a way that nothing was allowed anymore and then I just carried on. I can't just apply for unemployment benefits like: 'yes, I am not allowed to fly anymore', so you just continue. I mean, I have no alternative.*

Regulators responded to this kind of behavior by seeking to constrain it. They aimed to prevent illegal activities and stressed, as one Dutch rule-maker clearly stated, "law enforcement on illegal operations" (presentation at European Civil RPAS Policy, Regulatory & Innovation Forum, Brussels, 2017). Regulators also needed to create rules to reduce grey areas. For example, additional rules were created that needed to be "efficient [for the police] to control the use of drones", as a member of the European Commission claimed (presentation at EUROCAE Workshop in Brussels, 2016). As the police became better educated on the use of drones and the accompanying regulations, they were able to spot illegal behavior more easily and to fine the perpetrators. Nonetheless, this did not prevent all entrepreneurs from engaging in illegal activity. Respondent 23, an entrepreneur in the film and photography sector, made it clear that "if the penalty is only 350 Euro, I will take the risk of being fined; I'm still making the shot. Because if I get 10 shots and they only get me one time, well, so what?" Thus, for some, the risk of being caught and fined seemed out of balance in relation to the disproportionate potential upside of continuing to carry out illegal flights. Based on these "rather negative" (Respondent 16) experiences, regulators learned and created additional rules in an effort to prevent illegal activities from taking place.

Towards the end of this phase, it became obvious that there were many entrepreneurs who believed that their company did not need to adhere to current regulations, because their firm represented an exception or special case that needed to be dealt with separately. Regulators met this demand with a collaborative approach, as they understood that exceptions were necessary for some cases in which refinement was needed (*Changes in Regulation Needed*). This type of interaction was built on the acknowledgement that there were exceptions that went beyond the given regulatory context, for which regulators needed to redefine rules to facilitate entrepreneurial actions that could not be executed in adherence to current regulations. Thus, changes in regulations were needed for certain RPAS uses.

In sum, during this second phase RPAS activities occurred on both the international and Dutch scenes, and regulatory development at the EU level intensified. Attempts were made on all levels to propose policy guidance frameworks while entrepreneurial initiatives continued to grow. However, all of these efforts seemed uncoordinated, and although parties did acknowledge the work of others, arriving at common frameworks proved to be cumbersome. Many parties drew on different pieces of information and produced a range of proposals and frameworks. While interactions between entrepreneurs and regulators were frequent, all parties involved experienced the institutional friction of not yet having consolidated the plethora of disconnected regulations, which sounded in the transition to the next phase.

3.4.2.3 Phase 3 (2011 - 2015): Focused Efforts

In 2011, ICAO published a formal report on RPAS that became an important reference document for international RPAS regulatory developments. Then, in 2014, ICAO replaced the RPAS working group UASSG with a panel that was given the task to explicitly focus on supporting the regulatory process. One year later, ICAO published a RPAS Manual including more technical details on airspace integration and management. Supporting these international efforts, also in 2015, the

International Organization for Standardization (ISO) set up a subcommittee aimed at developing standards around RPAS. In its efforts to consider not only the national rule-making authorities, but also industry stakeholders, JARUS launched its Stakeholders Consultation Body in the same year to solicit feedback from the RPAS field as a whole. The European Commission organized a series of five workshops in 2011 to grasp what the challenges in the development of the European RPAS industry were. In 2012, the European Commission published a strategy document and created the European RPAS Steering group with the goal of drawing up a roadmap for RPAS integration by 2016, which was published the next year. Next to its existing RPAS working group, EUROCAE formed an additional working group in 2012, which only focused on smaller/lighter RPAS. The Unmanned Aerial Systems in European Airspace (ULTRA) consortium formed in the same year and presented their final report in 2013. Others also continued their work: EASA proposed an alignment of the European Common Rules of the Air in 2012, published a concept of operations for RPAS in 2015, along with a policy initiative to update its Basic Regulation of 2008. EASA also introduced a regulatory framework for RPAS operations the same year, and followed up with concrete proposals by the end of 2015. This regulatory framework mentioned three categories in which RPAS might be regulated in the future, based on their risk. In order to clearly map European regulatory developments, the DroneRules project was established in 2015. With a website as its main outlet, current rules of each EU country were made publicly accessible to foster awareness, clarity, and understanding. Another important European event of 2015 was the Riga Declaration, which was the result of an RPAS conference. The document talked about five principles on which the EU would focus its future efforts to stimulate the development of the RPAS industry. Half a year later, the European Parliament published a report supporting the removal of the existing 150 kilograms limit for EU-wide regulations. By the end of 2015, the European Commission adopted a new, comprehensive strategy for the European aviation sector. In the Netherlands, the Dutch industry association for RPAS was

founded in 2012. The previously issued rules for model airplanes were revised in 2013 to distinguish between leisure use and professional use. They also included the general prohibition to use unmanned aircraft up to 150 kilograms, but with the possibility to apply for an exemption when flying RPAS for commercial use. In 2015, rules for model airplanes were revised again with the publication of the first set of rules for commercial RPAS. Although commercial operators were not required to apply for an exemption anymore, other certificates were needed. In 2014, the Dutch Ministry of Justice and Security drew up an action plan for RPAS regulation. In the same year, the first lawsuit involving RPAS occurred as a Dutch journalist was fined for using his RPAS too close to an airport without permission. The Dutch Ministries of Safety and Justice, Infrastructure and Environment, and Economic Affairs collectively organized a conference in 2015 and issued a report expressing their views on RPAS afterwards. This was followed by a general consultation in the Dutch House of Representatives, which discussed RPAS-related issues.

During this phase, disregarding entrepreneurial behavior that was met with constraining regulatory responses (*Why Care about the Rules?*) slowly phased out. Especially in the Netherlands, the lawsuit against the journalist who flew his RPAS without permission during the phase of *Focused Efforts* represented a milestone in this regard. Ultimately, regulators sought to find "a good balance", as "you will always have drone operators that fly illegally" (Respondent 25). As the regulatory context was still in its infancy, the first set of regulations was created to "allow people to start flying drones" (Respondent 24) and rule-makers were aware that they would subsequently need to add more rules. A Dutch rule maker who was involved in this process recalled that, after the initial publication of new regulations, "we immediately published a future plan, immediately after the regulations: this is where we want to go, that's what we refer to as our policy intentions."

Entrepreneurs who valued existing regulatory frameworks continued to interact with the regulators seeking to enforce them (*Playing by the Increasingly Clearer Rules*). Interestingly, some entrepreneurs even expressed that their customers asked more of them in terms of safe and secure operations than what current rules demanded at that point in time (personal communication). In such cases, entrepreneurs spoke of "[s]mart customers [d]emanding much more than regulation requires" (presentation at AUVSI's Unmanned Systems Europe in Brussels, 2015). Thus, in addition to complying with regulations, the market itself occasionally required more from some RPAS firms.

During this phase regulatory frameworks were frequently refined, and co-creation activities between entrepreneurs and regulators continued. Rule selection processes were initiated when entrepreneurs felt constrained in their development of new business models (*Working on Better Regulation*). According to one entrepreneur: "legislation has quite been a problem, quite often you couldn't do things, you weren't allowed to do things or a new law was being put in place" (Respondent 6). New RPAS applications often did not fit extant regulatory frameworks, testifying to the fact that "[t]echnology has always preceded regulation" (presentation at ICAO's First Global RPAS Symposium in Montreal, 2015). While the industry was still forming and proto-institutions were still in flux, regulations were subject to virtually continuous change. So much so even that Respondent 8 expressed his concern that "at a certain moment, there will be more and more rules, and more…" There was a desire for the government to "talk more openly with industry players, like us, to introduce legislation that is more structured and not make all sorts of sudden changes" (Respondent 6).

During this phase, many entrepreneurs requested to be treated as an exception to the rules, as many new business models did not fit the extant regulation (*Changes in Regulation Needed*). Especially when entrepreneurs were able to demonstrate that their operations were safe, regulators showed their willingness to

refine existing rules to permit useful RPAS applications. As a Dutch policymaker stated: "Of course we also try to look ahead. And it's important that you do so together. Otherwise, we won't get there!" (Respondent 24). For example, Respondent 9 founded a company aiming to operate RPAS at airports for the purpose of pest control, as many airports face challenges with birds damaging aircrafts when aircrafts and birds collide. The issue here was that airports are no-fly zones for RPAS, while they would obviously benefit from the entrepreneur being exempted from the rules. This entrepreneur realized that the application of RPAS that he envisioned "is so specific that we need to keep on talking [with regulatory bodies]" to arrive at a workable solution. Such solutions should not make compromises with regard to safety, but they should also enable useful innovations. Many productive interactions between entrepreneurs and regulators were observed during this phase of *Focused Efforts*, during which Dutch rule-making activities intensified. Respondent 16, who worked at a governmental institution, stated that "if you want to do something that deviates from the rules, that's always possible if you can show that you'll be able to do it in a safe manner." In general, this group of entrepreneurs was aware that their input into the refinement of rules was essential for creating a future context that would be workable for them. Respondent 2, a producer of RPAS, stated that "[w]e have good contact with those who make the laws and regulations, and we are all on the same page. They also know that they need to change it to make sure that we can fly." He continued to stress that "a good dialogue with the authorities is very important". When presenting our findings on the types of entrepreneur-regulator interactions at an industry conference, we received feedback from an entrepreneur telling us that he was "exactly that special case" we had just talked about (personal communication). In response, during his presentation, he asked rule makers to put more effort into allowing operations for the greater good of society (as his firm uses RPAS to deliver humanitarian aid and disaster relief).

In sum, during this third phase even more regulatory activities accumulated in a short time span. Attempts were made to bundle efforts and focus on achieving the common goal – rule-making for a safe and secure integration of RPAS into the Dutch economy and into Dutch airspace – together. This resulted in collective standardization efforts, with recommended practices, guidance material, suggested standards and certification structures emerging in which rule-making bodies acknowledged and referenced each other's work. While interactions involving disregarding entrepreneurs who evoked rule proliferation by regulators became less prevalent, all other interaction types were still present during this phase. But even though the efforts of all actors became more focused on creating a common policy framework, they still experienced the institutional friction of not yet having established collectively binding rules, which greatly contributed to the transition to the next phase.

3.4.2.4 Phase 4 (2016 - 2018): Working Towards Harmonization

Internationally, the last phase was less eventful as European developments seemed to come to a common conclusion. ICAO published a preliminary concept of operation for RPAS in 2017 and the OECD released a report in which RPAS were discussed as part of the transportation mix for the first time. In the EU, SESAR Joint Undertaking published two studies in 2016: one on RPAS demonstration projects and one on the economic potential of RPAS for Europe. Also, EUROCAE merged its two separate working groups together to develop standards for all types of RPAS. The European UAS Standards Coordination Group (EUSCG) was formed in 2017 to work on RPAS standardization activities. The same year, EUROCONTROL published a concept of operation for integrating RPAS into air traffic management and the Airports Council International (ACI) followed a year later with a position paper on this issue. In 2018, SESAR Joint Undertaking published a roadmap for RPAS integration also considering issues concerning air traffic management. The year concluded with the Helsinki Declaration, which included a plea for light rules

and simple regulation and was published as a result of yet another European RPAS conference. EASA further refined the proposed categories for RPAS in 2017 and published its proposed regulations in early 2018, before the EU adopted the new Basic Regulation for aviation in the summer of 2018. As of that point, EASA was granted the mandate for rule-making regarding RPAS of all kinds, regardless of their weight. With the publication of a regulation aimed at RPAS of no more than four kilograms, the Netherlands made their last attempted in 2016 to introduce interim regulations, while the foreshadowing of EU-wide rules was already clear. In 2018, the Dutch House of Representatives organized a hearing and discussion session in which the Ministry of Infrastructure and Water Management sought more insights into the use of RPAS, their opportunities and challenges.

While some rules continued to constrain entrepreneurs in exploiting opportunities, regulators were still willing to facilitate entrepreneurship through rule selection (*Working on Better Regulation*). For example, with the introduction of new regulations covering RPAS up to four kilograms during the phase of *Working Towards Harmonization*, in July 2016 a conscious decision was made to reduce the administrative burden for entrepreneurs. Whereas certain new rules came into effect, less useful ones were suspended. One example is "abolishing the obligation to report to the mayor" (Respondent 24) when RPAS flights are executed. Also, RPAS operators were no longer required to have an operations handbook or a medical certificate, nor did they need to file a NOTAM, which is a notice about the upcoming flight with relevant information (Staatscourant, 2016). Respondent 25, a Dutch policymaker, explained that this was the case because "we wanted to look much more at the positive side. So, there was a real impetus to work, in particular, on being more stimulating". Upon realizing that certain rules were seen as constraining, regulators responded with facilitation in the form of selective rule suspension. This type of interaction slowly began to phase out when actors realized that the RPAS industry would soon be covered by EU-wide regulation, trumping national

legislation. "The EASA proposed to regulate all drones at the EU level" (presentation at the 3rd International Unmanned Cargo Aircraft Conference in Enschede, 2016), which was set in motion in 2012 (presentation at RPAS CivOps in Brussels, 2016). This meant that a number of Dutch national rules were to disappear. All EU member states and industries were invited to deliver insights for "best practices in the field of civil aviation [to be adopted] based on best available evidence and analysis" (presentation at RPAS CivOps in Brussels, 2016).

Eventually, *Playing by the Increasingly Clearer Rules* became the dominant type of interaction between entrepreneurs and regulators. For instance, a Dutch representative and member of the European Commission, stated that "enforcement of legislation is essential for the successful integration of drones into European airspace" (video shown at the RPAS CivOps in Brussels, 2016). To achieve this, EASA called for "compatible standards to support enforcement" (presentation at EASA Workshop on Drones in Cologne, 2016). But such standards require a joint effort, in which "gradual implementation of legislation and technology standards [go] along with the real needs of the industry" (presentation at the High Level Conference on Drones in Warsaw, 2016). In general, regulators expressed contentment with entrepreneurs and other industry parties that adhered to the current rules (personal communication). Rule reinforcement mostly acquired a confirmatory function, as commonly accepted regulations continued to exist. This became increasingly important as the process of proto-institutional emergence moved along to reach the end of the *Working Towards Harmonization* phase. The regulators' response was constraining, in that rules that were seen as workable by both parties gradually set the boundaries for future operations. However, in the event that entrepreneurs do not follow rules, "we have enforcers, we have the police and the Inspectorate and both have the responsibility to reinforce [the rules]", as a Dutch rule maker put it (Respondent 24).

In a similar vein, regulators continued to assume a facilitating role in responding to situations in which current regulations did not accommodate special cases. Further rule refinement was needed, as the "widened range of operations requires more regulatory flexibility to keep rules proportionate", as a member of the European Commission clearly articulated (presentation at EUROCAE Workshop in Brussels, 2016). In this emerging industry, "one size does not fit all" (presentation at High Level Conference on Drones in Warsaw, 2016). As such, Respondent 21, an employee of an intergovernmental organization with an advisory function, concluded:

> *Current rules may be fine for 99% of the existing firms in the industry, but nevertheless, there is still the 1% that is doing good work, but doesn't fit within regulations. In that case, governments should make exceptions, for example, flying at airports. Many won't be allowed and won't need to fly there, but, for example, for cargo purposes it may be necessary.*

In sum, in this fourth phase national and international stakeholders understood that the common European framework for RPAS rule-making was almost in place. Workshops and meetings were mostly organized with the intent to inform, not to regulate. Publications by stakeholder groups during that time focused on issues beyond the regulatory process, such as technology, infrastructure, or standards. All actors worked on arriving at a common agreement on how RPAS were to be understood, how they should be dealt with systematically, and how this should be reinforced appropriately and in a unified manner. The ending point of our analysis marks June 2018, when the EU adopted a common European regulation for all civil RPAS, regardless of their size or weight. This is an appropriate point in time, from which on the RPAS industry in the Netherlands is covered by EU-wide rules.

3.5 Discussion

3.5.1 Dialectic Institutional Work

Much of what we currently know about how institutions are created is derived from studies carried out in relatively mature settings, whose findings may not apply to technological innovation-intensive fields. Specifically, we feel that the logic of compliance, according to which entrepreneurs are considered to be institutionalized actors (somewhat devoid of agency) in a top-down regulated field, does not apply in emerging fields in which the core technological innovations are still imperfectly understood by society and in which institutionalized yardsticks for establishing legitimacy have not yet emerged. While more recent work recognized the importance of institutional entrepreneurs in the creation or disruption of institutions, we argue that this view lacks a fine-grained interactional understanding as entrepreneurs are often portrayed as heroic individuals who act in opposition to other stakeholders. Instead, a more interactive and dialectic vision is necessary, in which entrepreneurs are seen as the co-creators of their institutional surroundings and in which regulators frequently develop legal frameworks in consultation with pioneering entrepreneurs and in reaction to inexorable changes in such technological innovation-intensive and behaviorally fickle fields. Thus, the process of proto-institutional emergence that can be observed in these contexts closely resembles a dialectic approach[13] in which entrepreneurs and regulators work together in shaping the institutions of the future. Thus, both parties engage in *dialectic institutional work*.

Lawrence and Suddaby (2006) provide insights into institutional creation work and identify practices that focus on rules, namely advocacy work, i.e. “the

[13] We follow Zeitz (1980, p. 73) in our definition to refer to dialectics as “the basic logic of social interaction”. Although we do not apply techniques of dialectical analysis in our study, we propose that the processes we document can themselves be seen as dialectic, thereby following Benson (1977, p. 3) who claims that the “dialectical view is fundamentally committed to the concept of process”.

mobilization of political and regulatory support" (p. 221), defining work, i.e. "construction of rule systems that confer status or identity, define boundaries of membership or create status hierarchies" (p. 222) and vesting work, i.e. "the creation of rule structures that confer property rights" (p. 222). These activities are especially important in the creation of proto-institutions as the authors conclude that there is a "far greater potential for rules-based work to lead to the *de novo* construction of new institutions" (p. 228, emphasis in original). We find that this is also applicable for proto-institutional emergence in technological innovation-intensive fields as entrepreneurial action often precedes regulatory response. New entrepreneurial initiatives cannot be fitted into existing regulatory frameworks by mere extension of earlier frameworks, such as the body of regulations and conduct established in manned aviation. In the early beginnings of institutions, we especially observe advocacy work. Consequently, proto-institutions evolve processually driven by dialectic institutional work between two (or more) actors that contribute to structural emergence. Our contribution lies in shifting the focus from the agency-structure relationship to considering the actors' interactions more detailed by arguing that it is not only one group of actor that contributes to, challenges or creates structure.

3.5.2 Contributions

3.5.2.1 Institutional Work

Lawrence et al. (2011, p. 55) highlight that the "concept of institutional work insists on the need to consider the permanent recursive and dialectical interaction between agency and institutions" and existing studies in institutional work examined the relationship between agency and structure (Battilana, & D'Aunno, 2009; Canning & O'Dwyer, 2016). However, going beyond interactions between agency and structure, the micro-foundational processes by which actors come to shape structure, is also a product of interaction between these very actors. This has been largely overlooked by scholars focusing on institutional work processes. By introducing dialectic institutional work, we aim to shift the focus towards the interaction and

processes that occur between actors while engaging in the creation of new institutions. Thus, we take the discussion in institutional work literature one step further by not only shifting the "gaze away from the 'organizational field' and large-scale social transformations, and attend more closely to the relationship between institutions and the actors who populate them" (Lawrence et al., 2011, p. 57), but also to the relationship between actors themselves. Interestingly, Ozcan and Gurses (2018, p. 1793) point out that existing "institutional work has largely considered state actors as indistinguishable and static, and focused on reinforcing existing policies for institutional maintenance purposes". Our findings show, however, that the interaction dynamics are more nuanced and regulators do not form one monolithic body. We thus confirm the authors' findings and conclude that not only in regulatory category emergence, but also in proto-institutional emergence in technological innovation-intensive fields, the acts of regulators need to be considered more nuanced.

To our best knowledge, Hargrave and Van de Ven (2009) are the only scholars that attempted to introduce dialectics to the study of institutional work. However, in studying the interactions between institutional actors, the authors focus on "change [that] emerges from interactions between proponents of current institutional arrangements and parties espousing contradictory arrangements" with "new arrangements that […] are then challenged by proponents of alternative arrangements as the dialectical process recycles" (p. 122). This approach seems most suitable for institutional change as it assumes some degree of existing institutional arrangements, but profits from refinement when applied to institutional emergence. In settings of proto-institutional emergence where established views that need to be challenged are missing, our study provides insights into the process of dialectic institutional work by actors that are jointly engage in the creation of proto-institutions.

Eventually, Lawrence and Suddaby (2006, p. 249) urge scholars that only through studying the emergence of institutions using institutional work "theorists can avoid the subjective illusion of institutional outcomes and begin to unpack the relational and interactive moments of institutional production." We believe that with our study, we were able to follow this call and illustrate the interactions in the Dutch RPAS industry that drive proto-institutional emergence. This brings us to the contributions we make to literature on proto-institutional emergence.

3.5.2.2 Proto-Institutional Emergence

While Hargrave and Van de Ven (2006) conceptually lay out institutional innovation and change as a dialectic process within established organizational fields, our research adds to studies of new institutions by explicating the diverse entrepreneur-regulator interactions in this environment. Importantly, these actors within a newly forming, technological innovation-intensive field are actively involved in shaping proto-institutions that may or may not prevail in the future. As such, we followed the call by Bruton, Ahlstrom and Li (2010, p. 434) for researchers to consider the "institutional-individual mindset" connections that impact behavior and supply additional evidence of entrepreneurial behavior situated in its various contexts (Ucbasaran, Westhead & Wright, 2001; Zahra, Wright & Abdelgawad, 2014). We show that entrepreneurs are not only exogenous "rule-takers", but also influence the creation of the context they operate in as endogenous "rule-makers". Regulatory efforts occur in response to behavior espoused by entrepreneurs who partially, but actively share their future visions of the emerging institution with regulators, such that regulatory interventions do not only occur in isolation in a top-down manner (Bylund & McCaffrey, 2017). Regulations are not unlike entrepreneurial opportunities; they are socially construed as regulators observe and interpret how new organizational fields emerge while entrepreneurs aim to influence their efforts. Thus, we contribute to research on proto-institutional emergence by offering a deeper understanding of the dynamics that underlie the activities of

different actors in an emerging context exemplary for technological innovation-intensive fields. Eventually, the socially constructed reality in which entrepreneurs and regulators operate, exists and is redefined by their actions. Our study responds to the call by Douhan and Henrekson (2007, p. 22) who caution scholars not to be "restricted to analyzing how institutions affect the level and type of entrepreneurial activity", but instead to also "consider how entrepreneurial activities affect institutions". The shared construction of reality by all stakeholders involved in proto-institutional emergence extends beyond the assumption that regulators shape institutions in a one-sided manner. In our research, we have had the unique opportunity to reveal the dialectic institutional work that can shape future, taken-for-granted institutions even during the unstable, proto-institutional stage.

3.5.3 Limitations and Directions for Future Research

As we chose a specific organizational field in which to conduct our research, boundary conditions apply to our study, which simultaneously resemble fruitful directions for future research. First, since the Dutch RPAS industry is a context in which new technologies fuel the development of the field, interactions between entrepreneurs and regulators in less technology-driven fields may be different. For example, risks associated with system failures and crashes weigh heavily in the RPAS context, whereas these technology-related challenges are not as relevant in other fields. Future research may, therefore, look at organizational fields that do not form around technologies, but other products and services instead. Second, the Dutch RPAS industry is primarily a case of technology-enabled entrepreneurship rather than a case of technological development and diffusion. This entails opportunities for researchers with a particular interest in the regulation of new technologies. We believe that a comparative conceptual exploration of negotiation work (Helfen & Sydow, 2013) and dialectic institutional work would be a particularly interesting exercise, to assess which concept has the greatest explanatory power in such settings. Third, a salient feature of our research setting is

that a vast number of stakeholders in the RPAS industry has a background in or is familiar with manned aviation. This prior knowledge and familiarization with practices, conventions and codes in the manned aviation field may have impacted these actors' approach to interacting in the newly emerging field we studied. This offers interesting opportunities for researchers to more closely examine the influence of prior knowledge of or prior affiliation with a related industry on the formation of new institutions. Fourth, an interesting question is whether dialectic institutional work is conducive to the development of what Acemoglu and associates (2005, 2012) call 'inclusive institutions'. In their analysis, which contrasts such arrangements with 'extractive institutions' captured by political and economic elites, inclusive institutions are a main driver of equality and economic development because they enfranchise the human capital of otherwise disenfranchised non-elite actors. A speculative but interesting thesis to explore in future research is whether dialectic institutional work, which is by definition an open process that draws on the inputs of numerous entrepreneurs acting in concert with regulators, could be a process that is uniquely prone to producing inclusive institutions. It would appear that the involvement of multiple entrepreneurs in the process of proto-institutional emergence would ensure the continued openness of the resultant institutional structures towards future entrepreneurial initiatives and general enfranchisement of future generations of entrepreneurs. To sum up, we have illustrated interactions between stakeholders by means of a model that we believe accurately represents all that was observed in the emerging field we studied. However, because the complexity of processes in the social world may exceed what we were able to capture in our model, our study should be seen as a first step in this direction.

3.6 Conclusion

In this study, we asked: *How do regulatory proto-institutions arise in the type of technological innovation-intensive and behavioral change-prone organizational fields?* We conclude that the interactions between two types of central actors,

namely entrepreneurs and regulators, give a strong impetus to proto-institutional emergence. In particular, proto-institutions arise in technological innovation-intensive fields out of dialectic institutional work involving both of these parties, without either of them leading the process. This is illustrated in our process model, which we also expect to apply in some form in other nascent fields, including blockchain-based cryptocurrencies, platform-based sharing economy firms, and decentralized renewable energy generation. We therefore invite future researchers interested in these fields to scrutinize the settings for the effects of dialectic institutional work on proto-institutional emergence.

CHAPTER

4

Leviathan in a Lab Coat: How Military Initiatives Help Civil Innovation Institutions Produce Market-Ready Products

This chapter was prepared in collaboration with Pursey Heugens.

4.1 Introduction

An insight that has recently been established is that entrepreneurship and innovation need institutions to flourish (Acs, Desai & Hessels, 2008; Batjargal et al., 2013; Boettke & Coyne, 2009; Bruton, Ahlstrom & Li, 2010; Mazzucato, 2013; Spencer & Gómez, 2004). Feldman and Massard (2012), for instance, studied institutional factors in the geography of innovation as important innovation enhancers, which support knowledge spillovers, regional specialization, innovation clusters or university-industry knowledge transfers. Nooteboom (2000, p. 916) already established that "[l]inkages between firms can enhance both the diffusion and the generation of innovations". In doing so, Rasiah (2017) argues, governments play an essential role in providing institutional arrangements that allow for innovation to take place by bringing together various stakeholders, which resolves coordination and social capital exchange problems. However, if these networks become too tight and exclusive, they can form a liability by creating inertia that hinders future innovation (Nooteboom, 2000). Also, institutions are necessary for encouraging social entrepreneurship (Dorado & Ventresca, 2013), and varying institutions among countries are the reason for different rate and types of entrepreneurship (Sambharya & Musteen, 2014; Stenholm, Acs & Wuebker, 2013; Urbano & Alvarez, 2014).

Traditionally, however, the focus has been on public and private civil institutions such as university systems, investment communities and facilities, and R&D clusters that are thought to contribute to a country's innovativeness. For instance, many policy initiatives that aim at stimulating innovation focus on supporting (small) firms in the private sector, and promote entrepreneurship among new start-ups (Baron & Tang, 2011; Marvel & Lumpkin, 2007; Mintrom, 1997; Wong, Ho & Autio, 2005). While these are valuable insights that could be generated into public and private civil institutions and their impact on country-level innovativeness, this is only a piece of the puzzle. This is because the institutional

matrix (North, 1991) necessary for producing frame-breaking innovations tends to be incomplete in many contexts. For example, many attempts to produce private sector innovations fail because these initiatives: (a) lack complementary assets (Teece, 1998; Tripsas, 1997); (b) suffer from short-term investment horizons (Bertoni & Tykvová, 2015; Cumming, 2007); (c) underinvest in fundamental and precompetitive research (Feller, Ailes & Roessner, 2002; Niosi, Saviotti, Bellon & Crow, 1993), and (d) lack the 'translational' capacity to help products stemming from fundamental and precompetitive research become market-ready (Carayannis & Alexander, 2004; Woolf, 2008).[14] Radical innovation is fueled by technological breakthroughs as much as specialized human capital. Intellectual property is needed as well as dedicated financing, which is not always supported by public and private institutions in the civilian domain. In addition, private sector innovators are often reluctant to take risks when it comes to pioneering, radical innovations (Mazzucato, 2013). There is a certain capital commitment involved that these institutions are unwilling or unable to sponsor, as chances for success are difficult to access in very early stages and for very new technologies. In these cases, regulatory interventions and political authority are needed that private sector firms, even the ones focused on innovations, are unable or unwilling to provide. The time-horizon for (recovering) these investments may also be longer. Eventually, a country's innovativeness also depends on capacities that are built around the new innovation as well as adjacent institutions that are present to support them. While public and private civil institutions face difficulties in these areas, we posit that there is another

[14] These gaps in the institutional matrix are not unlike institutional voids, as they are often referred to in the literature. However, the term institutional void is often used to refer to emerging economies with omissions in basic institutions providing healthcare, schooling, and justice. The type of gaps we refer to, however, also exist in many fully developed economies, which therefore differ greatly in their ability to take the lead in producing frame-breaking innovations. We therefore refrain from using the term institutional void, in order to avoid confusion between missing generic institutions (i.e., 'classic' institutional voids) and incomplete institutions for innovation.

institution essential for innovation, which has thus far been overlooked by research but is able to compensate for existing institutional shortcomings: the military.

We use a sample of 1,341 civil drone systems that were created by 473 producers residing in 52 countries to examine the global drone industry from 2006 to 2016. These are drones that were developed with a commercial purpose and that do not constitute exclusively military systems. In particular, we employ survival analysis and test the influence of military drone presence, military expenditure, and arms import on civil drone market readiness. Our results show that common state institutions are not always sufficient in supporting national innovation, and researchers previously oftentimes overlooked the role that military institutions play for civil innovation around the globe. Our hypotheses are supported and we can confirm that through facilitating military-driven technological and human capital spillovers, investing in high-risk innovation projects, as well as building capabilities and adjacent institutions, the military contributes to increased chances for civil drone market readiness. It means that, although some private and public civil institutions help in bringing innovation to the market, the military is an undervalued, yet strong predictor for a country's innovative strengths in the civil sector.

This underestimated set of institutions for innovation – military institutions – remains a blind spot in many innovation studies. Nevertheless, the military is an important source of innovation that is often overlooked by management scholars, although the implications of military innovation for civil product development are widely used in daily life: the Internet was originally developed by a specialized American defense agency (Abbate, 1999), and even Silicon Valley is a product of efforts from the defense sector to support it (Leslie, 2000). Another example is the iPhone that draws from countless military innovations (from cellular technology and GPS to artificial intelligence), and successfully deployed them in their product (Mazzucato, 2013). This serves as a great example in which a number of dispersed innovations from the military can be integrated on the basis of political authority

rather than on the basis of consent (demand/supply matching) in free markets. Next to these spillovers, the military has the ability to invest in uncertain, long-term, possibly high-risk innovation projects, and military institutions also build capabilities and adjacent institutions (e.g., infrastructure) next to developing new products that others can profit from.

This study's contributions are twofold. To start with, we explicate the specific mechanisms through which military initiatives augment and enhance common public and private innovation institutions. Concretely, we specify three specific pathways through which military structures contribute to helping civil products to market-readiness. To our best knowledge, this study belongs to the first ones that systematically examine civil product development driven by military innovation in a global context. With this, we seek to contribute to the discussion on institutions for innovation, where little attention is paid to concrete institutions (such as the military) to enhance innovation. While existing research has a strong system-theoretical emphasis on economic explanations for generic institutional quality, we urge management scholars to engage in the discussion to determine which specific institutions are needed for innovation to flourish.

We also provide an account for the differential ability of national governments – even advanced ones – to produce breakthrough innovations. The civil innovative potential of countries differs drastically across the globe, and our study offers a novel (complementary) explanation for this observation; the extent to which countries complement common public and private sector innovation investments with matching support for military products and technology. In short, we show that the military-civilian symbiosis is an often overlooked driver of the innovation capacity of countries. This has implication for policy-makers, who may wish to not only consider but also support possible innovation outcomes that can arise from successfully leveraging military products and technology in the civil domain.

4.2 Theory and Hypotheses

4.2.1 Institutions for Innovation

It has long been a central tenet in institutional economics that there is an intimate relationship between *generic* institutional quality and (economic development through) innovation (Acemoglu, Johnson, & Robinson, 2005; Kuznets, 1973; North, 1991). The idea here is that political, economic, and legal institutions differentially facilitate, incentivize, and protect innovation-based economic growth initiatives. Institutions enable innovation by putting in place the necessary facilitative conditions for it, including accessible, high quality school systems, technical universities, and labor and capital markets. Institutions also incentivize innovation, for example by establishing tax facilities offering tax breaks for innovative companies, reducing the taxation of innovator-entrepreneurs. In addition, institutions can protect innovation by offering innovators access to functioning courts, establishing a strong intellectual property rights regime, and actively policing transgressors of those rights.

Although researchers stress that these National Systems of Innovations (NSI) are "an institutional conception *par excellence*" (Filippetti & Archibugi, 2011, p. 179, emphasis in original), this concept is prominently discussed in the innovation economics literature. There, the influences of the institutional context on the economic agent or organization, and their determinants for a countries' innovation capacity are discussed (Freeman, 1995; Lundvall, 1992; Nelson, 1993). The concept has been split into sub-parts and researcher studied not only on the level of *national* innovation systems, but also *regional* (Asheim & Gertler, 2005; Cooke, Uranga & Etxebarria, 1997; Feldman, 2014) or *sectorial* (Breschi & Malerba, 1997; Malerba, 2002) systems of innovation. Others even proposed the need for national systems of entrepreneurship (Acs, Autio & Szerb, 2014).

Thus, in addition to the need for a high-quality matrix of background institutions, scholars in management have long pointed to the need for more *specific* institutions behind innovation. The belief here is that more specific institutions are necessary to facilitate the emergence of innovation in each organizational field, since the configuration of actors, ideas, and technologies is unique to each field in particular. The literature on innovation, institutions, and organizations describes two principal routes for the emergence of such dedicated institutions in specific organizational fields. First, the organizations constituting an organizational field collectively often form innovation communities (Leonard-Barton, 1995; Lynn, Reddy & Aram, 1996; Saxenian, 1990). In such communities – virtual or co-located – dedicated de-facto institutions like highly specialized labor forces, supplier networks, technological standards, and dominant designs tend to emerge through both spontaneous and concerted efforts. In other words, new institutions for innovation often emerge endogenously from the interactions between organizations that are co-constitutive of organizational fields. Second, organizations embedded in fields also often make generic (extra-field) institutions specific by using them as resources or inputs into field-specific organizational processes and routines (Coriat & Weinstein, 2002; Hargadon & Douglas, 2001; Nelson, 2002). This transformative process makes dedicated institutions out of general ones by reinterpreting, reusing, and reinventing existing institutions. The process is often observed in relation to technological standards, open source initiatives, and platform technologies. In short, field-specific institutions for innovation tend to come into being either through specific, intra-field, endogenous processes or generic, extra-field, exogenous processes.

4.2.2 Importance of the Military for Innovation

One of the public areas in which many countries invest large amounts is the military and defense industry. For instance, it has been shown that the state had major influence on the development of the commercial aircraft industry, as this was driven

by military research, development, and production (Ruttan, 2006). Ruttan (2006, p.7) also shows that in the US, technologies that sprung forth from the military industry became essential parts of a number of industries that would not be as advanced as they are today, notably "(1) interchangeable parts and mass production, (2) military and commercial aircraft, (3) nuclear energy and electric power, (4) computers and semiconductors, (5) the Internet, and (6) the space industries."

In an early study exploring cooperation between rival firms in the aerospace and defense industry, Dussauge and Garrette (1995) found that alliances are responsible for a great proportion of all partnerships in the manufacturing, and the aerospace and defense industry in particular. In a similar vein, Hislop (2000) examined how UK military equipment manufacturer responded to declining demand after the Cold War, and found that internal restructuring, diversification and joint ventures were the result. Azulay, Lerner and Tishler (2002) studied intrapreneurial efforts to enhance conversion of military technologies for civil applications in an Israeli defense firm. While management encouragement let to more proposals by the employees, they continued to focus on military applications and not civilian ones. The authors conclude that this results from barriers that employees of defense organizations perceive in converting military applications to the civil market. Also managers in high positions seemed to inhibit this conversion. Honig, Lerner and Raban (2006) also focused on the Israeli defense industry, but studied linkages between the military system and start-ups. In particular, the authors found that start-ups with linkages to the defense industry could better access capital as their military ties signaled favorable performance. This could be confirmed by the authors as firms that acted as military supplier indeed showed better performance. Only recently has there been some interest in institutional influence from the military on management. Koch-Bayram and Wernicke (2018) show that CEOs with military background were less likely to be involved in making false claims on their firm's financial statements and opportunistic stock option backdating. The authors focused on CEO

characteristics obtained through their military experience, that is, law obedience and close adherence to regulations. Hiatt, Carlos and Sine (2018) showed that new ventures with ties to the military in underdeveloped, and developing countries increased their survival rates, mostly because of the supporting resources provided by the military, especially security-related ones.

Although some previous studies seem to indicate that the military impacts private sector firms in various ways, we lack insights into the mechanisms of institutional support that can be leveraged from the military to the civil sector. While research on high-level, public institutions as well as private sector institutions offers some insights, they only seem to account for part of the innovative capabilities of a country. Only a limited number of studies exist that look at the influence of military institutions' spillover into other domains, and research on their impact on innovativeness is essentially absent. Thus, we ask: *how can the military support civil innovation institutions to develop market-ready products?*

4.2.3 Military Spillovers

To start with, we argue that the military is capable of facilitating military-driven human capital spillovers (Acosta, Coronado, & Marín, 2011; Feldman, 1999; Lerner, 1992; Niosi & Zhegu, 2005). We define human capital spillovers as instances in which knowledge workers leave military organizations and embed their knowledge in civil settings to be exploited in complementary firms or products. Through these spillovers in human capital, technology spillovers occurs as well as a result.

The military creates a labor pool of skilled workers that possess knowhow on drone system development, but when they change jobs and are employed in commercially operating firms, these workers are able to leverage their knowledge in new settings (Honig et al., 2006). Human capital spillover can result from personnel leaving the military and either bringing their skills into private sector companies, or starting their own firm (McDonald, 2013). These newly founded

firms could also be spin-offs that result from the military selling part of their operations and thus, making it available on the market. In doing so, human capital built in the military will transfer to and be available in the private sector. Furthermore, ex-military personnel might also work with or for military suppliers, which in turn, feed back into the military system and facilitate future developments in the military itself. As a result, military-driven technological spillovers occur. Facilitated through the expert knowledge of former military employees, certain system parts or technologies from the military find their way back to be applied to civil products (Acosta et al., 2011; Eliasson, 2011).

An illustrative case is discussed in Mazzucato (2013) in great detail, namely Apple's iPhone. The author illustrates that many technologies that are deployed in their smartphone stem from advancements in the military, often in cooperation with universities and research institution, but also private sector firms. For instance, the iPhone's artificial intelligence aided assistant SIRI was originally developed for military personnel, and the multi-touch screen sprung forth from a research fellowship program initiated by the U.S. National Science Foundation and Central Intelligence Agency. For military drones, it can either be a certain technology, such as GPS that is leveraged, or the whole drone system that is not only utilized for military purposes, but also applied by supplying firms to the civil sector. Thus, some example exists in which technology developed for and used by the military finds its way into civil products (for another impactful example, please see the development of Internet as discussed in Abbate, 1999). Also novel applications of the technology are possible and, as Goel and Saunoris (2018, p. 363) suggest, "knowledge spillovers from defense products might enable entrepreneurship in the civilian sector via new products or civilian applications. Knowledge embedded in sophisticated military technologies can yield useful ideas for civilian applications." Thus, with an increasing share of military drone systems in a country, we can also expect to see products from the military to be deployed in the civil setting. Lastly,

not all firms that develop (parts for) military drones need to be purely military firms themselves. Some companies participate in tenders for the military, but are serving the civil market as well. Knowledge that is gained during military projects is then taken into consideration for civil product development (Baum & McGahan, 2009). It also occurs that civil actors cooperate with military parties to jointly develop much needed technology (Cowan & Foray, 1995; Molas-Gallart, 1997; Te Kulve & Smit, 2003).

In summary, human capital spillover effects enable military drone development to also contribute to enhanced developments of civil systems. With a greater share of military drone systems in a country, a higher density of knowledge and innovation from military drone development is present, which in turn can be used in civil systems. The mechanisms through which this happens are spillovers in human capital from the military, which lead to technological advancements in civil products. Thus, a high share of military systems in a country either being developed or already on the market indicates a strong emphasis on knowledge around military drone technology. Through spillover effects, the enhanced technology and innovation in this domain can be utilized in civil drones.

> *Hypothesis 1: The higher the share of military drones developed in a country, the shorter it will take civil drone systems that are developed in that country to reach market readiness.*

4.2.4 High-Risk State Investments

While spillovers from knowledge around products developed by the military play a vital role, we argue that it only represents one mechanism through which civil innovation can be fostered. In addition, we posit that the military's capability to invest in high-risk project represents another mechanism that is responsible for enhanced developments of civil systems. We define high-risk investments as

investments that have uncertain outcomes, a long investment horizon, leave room for experimentation and failure (Mazzucato, 2013).

These fundamental investments need to be given for radical innovation to occur. Civil institutions – private firms and even public ones – are often reluctant to engage in these projects themselves due to their limited risk propensity. However, if a government is dedicating funds to their military, especially for cutting-edge technology and research projects with uncertain outcomes, the investments made can be expected to end up, at least in part, in R&D and technology development within the military. Among other R&D activities, it will affect the advancement of military products (Balfoussias & Stavrinos, 1996; Mowery, 1992; Palme, 1982; Yildirim & Öcal, 2016). These innovations can then be sources by other public and private parties. Mazzucato (2013, p. 31) concludes that following the military's heavy investments in early Internet development project, "venture capital arrived 15–20 years *after* the most important investments were made" by the US Department of Defense.

Another way in which governments invest in risky projects is through directly funding private or public firms in undertaking project that they would not have carried out without military funding. Caterpillar serves as an excellent example of a company that is profiting from governmental support through their military spending not only to strengthen its defense section of the business, but at the same time to support their other business unites. The company's core is focused on machinery and engines, which are purchased by corporates as well as governments, notably with the US Government being its largest customer (Reuters, 2019; National Mining Association, 2019). Starting around World War I, its early tractors were used to carry equipment and artillery used at the battlefront and served to inspire the UK tank development (HOLT CAT, 2019), till today where Caterpillar equipment can be found in almost all US military missions one way or another (National Mining Association, 2019). From its early start in the 20th century, Caterpillar was

able to profit from governmental defense expenditure and only recently secured a contract of 663 million US Dollar (USD) to produce equipment for the US Defense Logistics Agency (National Mining Association, 2019). As a special kind of customer, the US military provides investments through contracts awarded for customized fleet equipment tailored to the State's needs (Army Technology, 2019). By doing so, investments are made for developments in the company's existing knowledge and technology base to satisfy the State's needs. Caterpillar might not allocate these funds internally when such projects are viewed as too risky and without immediate return. On the long run, however, innovation that results from these initially State-funded.

Thus, the military has the unique ability to be able to invest in high-risk projects that may or may not turn out to produce successful innovation (Abbate, 1999; Leslie, 2000; Mazzucato, 2013). Different from private sector firms, or even public bodies supported by general state funding, the military has more freedom to use funds for projects without quick and easy-to-reach targets and in experimenting with innovation, and is able to invest in projects that may be doomed too risky by others (Block, 2008). Often fueled by the determination of achieving a superior position compared to other countries when it comes to warfare, the willingness to engage in risky projects rises as the possibility for higher returns (thus, greater innovation and more military advancement) increases.

> *Hypothesis 2: The higher the military expenditure of a country, the shorter it will take civil drone systems that are developed in that country to reach market readiness.*

4.2.5 Capacity and Adjacent Institution Building

Lastly, indirect spillover effects may occur when governments compensate for their own shortcoming by refraining from complete military drone development themselves. Rather, they obtain necessary technologies and goods through imports.

However, this does not always lead to only military arms and technology itself being imported, but also to compensation orders for their own, national industry. In turn, these firms are able to build capabilities in these areas. With this opportunity, also other necessary arrangements are made, for example in infrastructure, which leads to newly emerging institutions in support of the capability-building activities. This is what we define as capability and adjacent institutions building.

Many countries, especially within the European Union, operate according to the *juste retour* principle, which is often referred to as a "principle of fair industrial return" (Burgess & Antill, 2017, p. 112). Orders for military weapons that are awarded to foreign firms should be compensated or matched by the same amount awarded to national producers (Mamadouh & Van Der Wusten, 2011). As an example, we turn to the procurement and development of the Lockheed Martin F-35 Lightning II, often referred to as the Joint Strike Fighter (JSF). This aircraft was developed and funded by a large number of international partners, categorized according to their financial commitment, delivery obligations, possibilities for technology transfer and sub-contracting. Among the top contributors, next to the United States taking the lead, were the United Kingdom, Italy, the Netherlands and Turkey. For them, as Vucetic and Nossal (2013, p.8) summarize, "the initial attractiveness of the F-35 program lay in its promise to keep the partners firmly located within US-led industrial and high-tech networks, while providing partners with relatively cheap access to latest-generation stealth technology." While these partners initially contributed to the JSF program, governments planned to recover initial investments by awarding contracts to industry firms, which then produced the actual systems (Van De Vijver & Vos, 2007). Although the ever increasing costs of the program are often discussed (Byers & Webb, 2011; Institute for Defense Analyses, 2010), Van De Vijver and Vos (2006) estimated for the Netherlands alone that the JSF program contributed to 120 million USD in spillover to the Dutch economy as a whole, and 1.1 billion USD in spin offs within the Dutch aerospace

industry. This happens either by firms creating technologies that can be applied to the military project in question, but also leveraged into other industries (spillover), or by firms working together and forming collaborations (spin-offs). Additionally, these companies may gain better reputation or additional contracts as a result of their engagement in the JSF program (Bisschop, Koopmans, Lieshout, Prins & Volkerink, 2012). Van de Vijver and Vos (2007, p. 513) even constitute that the "F-35 programme provides Dutch industry with the opportunity to participate in the development of a military fighter for the first time in its history." The Netherlands committed to buying more than 85 aircrafts in total. Thus far, in the Netherlands alone, there are 37 high-tech suppliers involved in the JSF program (Global Security, 2018). These programs are, through stimulating arms import, "securing a competitive industrial infrastructure and cutting-edge research and development capability for its aerospace sector and the wider 'knowledge economy' that surrounds it" (Scott-Smith & Smeets, 2013, p. 67).

Thus, the procurement of military weapons, heavy machinery, and aircrafts leads to a mediating infrastructure being established in which not only military arms and technology itself are imported, but also gains for local firms are achieved. The knowledge and knowhow acquired by these firms can then be utilized in related, non-military products as well, such as civil drone systems. There are, however, also other forms of capability development to be gained; while some partners were engaged in building to specification, especially for lower-tiered partners, where generic capabilities could be developed, others could benefit from co-developmental orders. These are particularly important as they result in a broader innovation pipeline for the firms, which can also be leveraged in other products, such as civil drone systems, and are not restricted to military deployment only. Eventually, capabilities and adjacent institutions emerge that are supporting innovation beyond military applications.

Hypothesis 3: The higher the military arms import of a country, the shorter it will take civil drone systems that are developed in that country to reach market readiness.

4.3 Methods

4.3.1 Research Context and Data

Remotely piloted aircraft systems (RPAS), or drones as they are commonly referred to, have a history of being used in the military, usually with a negative connotation. Missile strikes by drones received media publicity during the beginning of the century when the US employed them in Afghanistan (Gregory, 2011; McBride, 2009). Nonetheless, they are nowadays not only a preferred toy, but used for a great number of applications in many commercial industries. To name a few examples, drones are used for protection against wildlife poaching in Africa, they replace people in dangerous working environments such as oil pipe investigation, but also deliver medical supply in difficult-to-reach areas or are used by farmers for efficient crop monitoring. In Europe alone, total drone fleet size is estimated to reach 3,000 systems in the military sector by 2050, while 415,000 systems are employed for government and commercial purposes and 7 million are used for leisure purposes (SESAR, 2016). The United States aims at a fleet size of around 14,000 military systems by 2035, and another 70,000 systems for state agency use, while commercial and leisure systems should reach around 175,000 systems (U.S. Department of Transportation, 2013). It is clear that drones in the civil sector already form an integral part in many industries, albeit having a long-standing history in the military.

Our research context forms the global drone industry from 2006 to 2016. In these 11 years, 2,537 drone systems that were created by 741 producers in 59

countries[15] were counted. A breakdown of the drone systems developed or market ready in these countries can be found in Table 4.1. In order to prevent information overload, yet illustrate changes within and differences between countries, we selected three time periods: the start of the observation period in 2006, the midpoint which marks 2011, and the end of the observation period in 2016.

Globally, big differences exist between countries in the total amount of drones (in all kind of development stages and for all kind of usages). In 2006, the United States could count 218 drone systems; more than four times as much as runner-up Israel. However, the majority of countries (73%) were holding five or less drones by that time, while only 22% did so in 2016. Also in 2011 and 2016, the United States remains leading the list of total drone systems, and shows the biggest overall growth in drone systems throughout the observation period gaining 266 new systems between 2006 and 2016. China was able to increase their drone amount in more than tenfold from 19 systems in 2006 to 217 systems in 2016. Notably, drones in Brazil grew from just 1 system to 33 systems during the same period. Reversely, Croatia and Tunisia could not show for any drones in 2016 anymore, while starting out with 3 and 2 systems in 2006, respectively.

Considering military drones only, China gained 53 systems during the observation period. Again, the largest producer of military drones remains the United States with 138 military systems in 2006, 221 military systems in 2011, and 146 military systems in 2016. 18 countries remained with no military drones recorded in their country in 2016, a slight decrease from 2006 in which 24 country did not engage in developing or commercializing drones in any way. France and the United Kingdom downsized during our observation period going from 27 and 23 military systems to 9 and 14 military systems, respectively. In terms of drones that were developed or on the market for commercial/civil application, however, France

[15] Taiwan was already excluded due to a high amount of data systematically missing.

increased their numbers massively from 1 drone system in 2006 to 77 drone systems in 2016. Interestingly, overall commercial/civil drone presence was rather small at the beginning of the observation period compared to the amount of military drones: only the United States and Japan had more than five commercial drones in their country by 2006 (14 and 7 systems, respectively). By 2016, however, one-third of all countries had more than five civil systems in development or available on the market. The situation is similar for hybrid drones, i.e. drones that were developed with the purpose of serving both, the military and the civil market, and shows an even steeper growth. While only 71 hybrid systems were available in 19 countries in 2006, 531 hybrid systems can be counted in 39 countries in 2016. It comes as no surprise that the United States also heads the list of most hybrid drones in 2006 (28 systems), 2011 (70 systems), and 2016 (139 systems). It is remarkable, however, that China went from no hybrid drones at the beginning to 60 hybrid systems by the end of the observation period.

For further analysis, we employ a sample of drones that are produced for civil use, including drone systems that are hybrid, i.e. intended for both civil and military use, thus leaving out all drones that were developed purely for military purposes or for any other use (e.g. research). Our sample then comprises 1,341 drone systems that were created by 473 producers residing in 52 countries[16]. This eventually led to 5,735 drone-year observations. This data was collected by the industry association Unmanned Vehicle Systems International (UVS International) and published annually in the RPAS Yearbook with all unmanned aircraft systems globally recorded.

[16] Although Ecuador, Estonia, Romania, Serbia, Tunisia, the United Arab Emirates and Vietnam engaged in drone system development, none on these countries engaged in civil or hybrid drone development and thus, were excluded from the sample.

	2006				2011				2016			
Country	**Total Amount of Drones**	**Thereof: Military Drones**	**Thereof: Commercial/ Civil Drones**	**Thereof: Hybrid Drones**	**Total Amount of Drones**	**Thereof: Military Drones**	**Thereof: Commercial/ Civil Drones**	**Thereof: Hybrid Drones**	**Total Amount of Drones**	**Thereof: Military Drones**	**Thereof: Commercial/ Civil Drones**	**Thereof: Hybrid Drones**
Argentina	0	0	0	0	16	13	3	0	18	15	3	0
Australia	13	3	4	3	24	3	11	4	34	3	21	4
Austria	2	1	0	1	8	2	4	2	13	0	6	3
Belarus	0	0	0	0	0	0	0	0	16	4	9	2
Belgium	1	0	1	0	5	1	4	0	14	0	12	0
Brazil	1	0	0	0	8	0	1	4	33	3	7	20
Bulgaria	1	1	0	0	4	2	0	2	4	2	0	2
Canada	2	1	0	1	18	2	13	3	37	2	30	5
Chile	1	0	0	1	5	2	0	3	7	4	1	2
China	19	19	0	0	53	47	0	4	217	72	85	60
Colombia	0	0	0	0	4	0	1	0	4	0	1	0
Croatia	3	1	0	2	2	0	0	2	0	0	0	0
Czech Republic	1	1	0	0	7	2	0	2	12	3	0	5
Denmark	0	0	0	0	0	0	0	0	1	0	1	0
Ecuador	0	0	0	0	0	0	0	0	1	0	0	0
Estonia	0	0	0	0	0	0	0	0	4	0	0	0
Finland	0	0	0	0	1	1	0	0	2	1	1	0
France	44	27	1	9	74	25	17	28	121	9	77	28
Germany	22	20	0	1	51	19	16	15	90	16	45	16
Greece	1	0	0	1	4	2	1	1	3	2	1	0
Hungary	0	0	0	0	1	0	0	1	2	0	0	2
India	2	2	0	0	7	6	0	1	18	14	0	2
Indonesia	0	0	0	0	0	0	0	0	7	6	1	0
Iran	3	3	0	0	36	17	0	10	45	20	0	15
Israel	51	48	0	3	83	68	0	13	122	93	1	24
Italy	11	8	0	0	41	16	15	6	61	23	29	5
Japan	15	1	7	4	13	2	5	3	17	2	10	1
Jordan	3	3	0	0	3	3	0	0	3	3	0	0
Latvia	0	0	0	0	2	0	0	2	7	0	2	5
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0
Malaysia	1	0	0	1	4	3	0	1	3	1	0	2
Mexico	0	0	0	0	6	2	0	4	8	2	0	6
Netherlands	6	1	4	1	15	0	7	6	17	0	15	0

(table continues on next page)

	2006				2011				2016			
Country	**Total Amount of Drones**	**Thereof: Military Drones**	**Thereof: Commercial/ Civil Drones**	**Thereof: Hybrid Drones**	**Total Amount of Drones**	**Thereof: Military Drones**	**Thereof: Commercial/ Civil Drones**	**Thereof: Hybrid Drones**	**Total Amount of Drones**	**Thereof: Military Drones**	**Thereof: Commercial/ Civil Drones**	**Thereof: Hybrid Drones**
New Zealand	2	1	1	0	6	0	0	6	10	0	3	7
Nigeria	0	0	0	0	0	0	0	0	1	0	0	1
Norway	5	1	4	0	14	2	6	1	20	2	14	1
Pakistan	23	23	0	0	33	31	2	0	40	38	2	0
Philippines	0	0	0	0	1	0	0	1	1	0	0	1
Poland	2	2	0	0	6	3	0	3	18	4	4	4
Portugal	1	1	0	0	6	1	0	3	16	2	3	10
Romania	1	0	0	0	4	2	0	0	2	0	0	0
Russian Federation	22	15	1	5	65	24	1	35	105	33	12	50
Serbia	0	0	0	0	4	3	0	0	4	3	0	0
Singapore	8	5	0	3	10	7	0	3	15	5	1	3
Slovakia	0	0	0	0	1	0	0	1	2	0	0	1
Slovenia	1	1	0	0	6	4	0	2	10	3	0	7
South Africa	7	6	1	0	14	7	4	3	16	4	5	4
South Korea	8	6	1	1	26	16	3	7	33	16	6	11
Spain	8	4	2	2	36	6	15	14	52	6	20	25
Sweden	2	2	0	0	10	4	0	6	18	2	0	15
Switzerland	4	1	0	3	28	2	14	11	32	1	23	3
Thailand	0	0	0	0	0	0	0	0	2	0	2	0
Tunisia	2	2	0	0	2	2	0	0	0	0	0	0
Turkey	5	5	0	0	21	16	1	4	19	14	1	4
Ukraine	3	3	0	0	7	3	0	4	16	3	0	13
United Arab Emirates	1	1	0	0	8	8	0	0	10	10	0	0
United Kingdom	29	23	1	1	71	35	5	21	83	14	22	23
United States	218	138	14	28	401	221	26	70	484	146	80	139
Vietnam	0	0	0	0	0	0	0	0	1	1	0	0

Please note: Military, commercial/civil and hybrid drones may not add up to represent the total amount of drone systems as other uses are excluded from the table (e.g. drones for research purposes).

Table 4.1 Descriptive Information on Drone Systems (Selected Years, All Countries)

4.3.2. Measures

4.3.2.1 Dependent Variable

The dependent variable measures civil product market readiness in the drone industry and is a binary variable indicating whether a drone system is market ready in the given year and country. This data comes from UVS International's RPAS Yearbook in which all unmanned aircraft systems globally as well as their development status are recorded. We classify market readiness of a drone system by selecting products that were either ordered/entering service, in inventory and/or in service as well as fully developed. Products that were not market ready were either available as proof-of concept/demonstrator, in continued development or ordered as test/demo system.

4.3.2.2 Independent Variables

We test our hypothesis by including military variables. A countries' share of military drone systems, its military expenditure as well as its arms import were included.

Military Drones (% of Total): We use data from UVS International's RPAS Yearbook in which all unmanned aircraft systems globally are recorded as well as their usage. We then calculated the percentage of military drones by adding up the number of drone systems for military use and dividing it by all available individual systems in a given country and year.

Military Expenditure (% of GDP): We use data from the World Bank, which comprises a weighted average of data from the Stockholm International Peace Research Institute (SIPRI) and their own yearbook on Armaments, Disarmament and International Security. This data was complete for almost all of the target country-year variables. Missing values were taken directly from the SIPRI database.

Arms Import (log.): We use data from the World Bank, which comprises information from SIRPRI's Arms Transfers Program that captures trend indicator

values expressed in US Dollar (at constant 1990 prices). This data included heavy military weapons such as aircraft, missiles and ships, but excluded small and light weapons such as support equipment or technology transfers. We then calculated the natural logarithm as this data was highly skewed. While this data was complete for 91.2% of the country-year variables, the remaining values were imputed later on.

4.3.2.3 Controls

First, we include control variables related to a country's economic performance and size, its political constraints and government quality as well as incoming/outgoing foreign direct investments.

GDP (log.): We account for countries' wealth by including its gross domestic product (GDP) in the baseline model. Although research has shown that countries with higher GDP do not necessarily have higher rates of entrepreneurship (e.g., Uhlaner & Thurik, 2007; Wennekers, Van Stel, Thurik & Reynolds, 2005), this is likely due to higher levels of necessity-driven entrepreneurship instead of innovative entrepreneurship in low GDP nations. We thus include GDP to capture more prosperous countries' means to support the development of innovative products. We use data from the World Bank for a country's GDP in current US Dollar, which includes World Bank and the Organisation for Economic Co-operation and Development's (OECD) national accounts data. We then calculated the natural logarithm as this data was highly skewed.

Government Spending (% of GDP): Government expenditure indicates the size of a countries' government. It can be expected that larger countries with more government expenditure are also the ones that are able to contribute more to their counties' innovative climate, as resources are available for the benefit of its citizens, public goods and state investments (Dakhli & De Clercq, 2004; Furman, Porter & Stern, 2002). We use data from the World Bank's TCdata360 in which general government total expenditure as percentage of GDP is recorded. This data comes from the International Monetary Fund's World Economic Outlook and was almost

complete. Information for Iran and South Korea was missing and taken directly from data provided by the Heritage Foundation (Iran) and OECD (South Korea).

Political Constraints & Quality of Government: Countries with better governmental institutions show higher rates of entrepreneurship and innovation (Estrin, Korosteleva & Mickiewicz, 2013; Rodríguez-Pose & Di Cataldo, 2014). As the different countries in the sample have different levels of political constraints and governmental quality, it is expected that this will also have an effect on the support these institutions have for entrepreneurship and innovation and will, thus, be contributing to market readiness of drones. For measuring political constraints, we used data from Witold Henisz, who developed the political constraints index. This index measures a countries' feasibility of policy change by using information on the extent to which government policy change results from a preference shift of any political actor in that country. Scores range from 0 to 1 with higher scores indicating more political constraint (thus less feasibility of change) and lower scores indicating less political constraints (thus more feasibility of change). For measuring the quality of government, we use data from the PRS Group, who publishes the International Country Risk Guide, in which information on government corruption, law and order as well as bureaucracy quality are assessed. Each of these three variables receive a score, is then averaged and scaled with 0 representing the lowest quality of government and 1 representing the highest quality of government.

FDI Inflow & FDI Outflow (% of GDP): Finally, incoming FDI is seen as an important source of new technologies and know-how through skilled labor that are brought into the country. It has also been claimed that incoming FDI has a demonstration effect on local R&D where local technologies are inspired by foreign input or reverse engineering is employed (Cheung & Ping, 2004; Marcin, 2008). Thus, positive innovation spillovers from foreign countries can be expected if FDI inflow is high. Outgoing FDI is associated with the ability to leverage technology more broadly without being restricted to the home country (Keller, 2010). Thus,

outward FDI is thought to enhance export activities, which in turn generates demand for these products in the home country (Lipsey, 2004). We thus expect countries with high FDI outflow to show higher number of drones that are ready to be used not only in its home country but potentially also to be exported. We used data from the World Bank for a country's foreign direct investment as a percentage of GDP, which are the net inflows/net outflows of investment to obtain a voting stock of 10% or more of another company, thereby demonstrating a lasting management interest. These investment inflows/outflows are then divided by the country's GDP. The World Bank supplements its own accounts with data from the International Monetary Fund, namely from their International Financial Statistics and Balance of Payments databases, as well as the United Nations Conference on Trade and Development and other official national sources. This data was almost complete. For FDI Inflow (FDI Outflow), we were left with one (two) missing country-year values, which were imputed later on.

Next, we considered control variables that are more specific to the context we are studying. These are R&D expenditure carried out by private parties and by governmental bodies, the density of newly founded businesses as well as the total number of drone systems that can be found in the country.

Private/Public R&D Expenditure (% of R&D Spending): David, Hall and Toole (2000) conclude after reviewing an exhaustive body of literature on private and public R&D spending that results remain ambiguous as to whether public R&D spending is complementary to private expenditure or whether a substitution effect occurs. Nonetheless, research generally indicates that higher R&D expenditure is associated with greater innovation on country level (Bilbao-Osorio & Rodríguez-Pose, 2004; Furman, Porter & Stern, 2002) and thus, we expect R&D spending – from private as well as public sources – to affect innovation in a country positively. For private R&D expenditure, we used data from the UNESCO Institute for Statistics (UIS.Stat) to determine the share of R&D expenditure that is coming from

the business enterprise sector, while we also use data from UIS.Stat for public R&D expenditure to determine the share of R&D expenditure that is coming from the government sector.

New Business Entry Density: The foundation of new businesses and high numbers of entrepreneurial entry into the economy are viewed as determinants of a flourishing and innovative economies (Autio & Fu, 2015), up to the point where some authors state that "[e]ntrepreneurial activity and new firm formation are unquestionably considered to be engines of economic growth and innovation" (Giannetti & Simonov, 2004, p. 271). We use data from the World Bank's Doing Business project, which provides the number of newly registered corporations (regardless of their size) per 1,000 people of working age. While this data was complete for 69.5% of the country-year variables, the remaining values were imputed later on.

Total Drone Systems: We posit that the total number of drone systems that can be found in a country (regardless of their development stage) have an influence on the market readiness of this countries' drone systems. Thus, with more drones in a country, the number of drones that reach market readiness increases as a function of increased technological knowledge and higher drone specific skills. We use data from UVS International's RPAS Yearbook in which all unmanned aircraft systems globally are recorded. We then calculated the total number of drone systems by adding up all available individual systems in a given country and year.

4.3.4 Data Preparation

We spent a considerable amount of time in collecting, cleaning and constructing the database that we needed for testing the hypotheses. To start with, data from UVS International's RPAS Yearbook was publically available, however only in a sort of scanned PDF format. All information thus had to be manually transferred into a database. Several checks on data completeness and consistency needed to be

performed afterwards on the more than 14,000 drone systems-year observations. We mostly went through our database line-by-line to check if the information was identical to the original source. We also got help from a research assistant to perform an additional check manually. Eventually, different ways of name spelling needed to be harmonized as each drone system and each drone producer received a unique identifier.

Next to information on product level concerning drone systems globally, we collected information on institutional variables for all countries. Taiwan was excluded from all analyses as data was systematically missing. As we could not assume that this data was missing completely at random, Taiwan has been excluded from further analyses.

Data that was missing and could not be obtained from another data source was imputed by means of multivariate imputation using chained equations (MICE) with 50 imputations and 500 iterations, which is also known as the fully conditional specification method (e.g. Van Buren, 2007). The use of this method is recommended in studies containing longitudinal data (De Silva et al., 2017). Eventually, 19% missing values needed to be imputed for the variables *Private R&D Expenditure* and *Public R&D Expenditure,* 30.5% for *New Business Entry Density* and 8.8% for *Arms Import*. Consequently, all following analyses were carried out with the imputed datasets.

4.3.5 Data Analysis

We employ survival analysis to test our hypotheses. This approach allows us to take the time until an event occurs into consideration, in this case the moment when a drone system becomes market ready. We use Cox proportional hazard regression modelling which utilizes the unique characteristics of the data such as censoring (Cox, 1972). It helps us to handle right censoring that occurs in the data (i.e. instances in which a drone system starts the development process within the

observation period of the study, but does not reach market readiness within this time), as it accounts for this data until the end of the observation period (Allison, 2004). In our sample, observations for 590 drone systems are right-censored. For some drone systems, left censoring occurs as we cannot identify the starting point of development of the system if it was before 2006, but observe the instance that the system reaches market readiness within our observation period. An additional 64 drone systems were excluded as they already reached market readiness before we could observe them (before or in 2006). Out of the 5,735 drone system-year observations, we were left with 3,185 drone system-year observations. These include 1,341 drone systems experiencing 865 market readiness events, and 1,129 total analysis times at risk and under observation. In case of coinciding market readiness events, the Efron method was used to handle these ties (Allison, 2014). Also, we employed robust estimators for standard errors clustered by drone system.

4.4. Results

4.4.1 Hypotheses Testing

In Table 4.2, descriptive statistics and correlation statistics are reported. Correlations between the main variables that we use for testing our hypotheses are moderate to low, with correlations well below 0.4. In two instances, however, military expenditure correlates moderately with the total amount of drone systems (0.59) and the total share of military drones (0.6). This means that countries with higher military spending also have more drone systems, as well as higher shares of military systems among the total. For the remaining control variables, the strongest correlation can be found between FDI inflow and FDI outflow (0.88), GDP and total amount of drone systems (0.79), private and public R&D expenditure (-0.77), as well as governmental quality and political constraints (0.7).

In Table 4.3, descriptive information about the dependent and independent variables are presented, for years 2006, 2011 and 2016 as it was with Table 4.1.

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
1. GDP (log.)	28.40	1.48	–												
2. Government Spending (% of GDP)	41.39	9.94	-0.198	–											
3. Political Constraints	0.7325	0.2095	0.191	0.003	–										
4. Quality of Government	0.7351	0.1859	0.176	0.094	0.696	–									
5. FDI Inflow (% of GDP)	2.88	5.29	-0.148	-0.087	0.016	0.146	–								
6. FDI Outflow (% of GDP)	3.00	5.63	-0.107	-0.036	0.087	0.219	0.877	–							
7. Private R&D Expenditure[a] (% of R&D Spending)	52.98	14.03	0.577	-0.114	0.084	0.423	-0.070	-0.003	–						
8. Public R&D Expenditure[b] (% of R&D Spending)	34.92	13.78	-0.310	0.018	-0.219	-0.605	0.009	-0.009	-0.771	–					
9. New Business Entry Density[c]	4.21	3.87	-0.112	-0.196	0.001	0.296	0.108	-0.032	-0.177	-0.054	–				
10. Total Drone Systems	128.98	151.51	0.793	-0.231	0.197	0.198	-0.124	-0.119	0.387	-0.324	-0.062	–			
11. Military Drones (% of Total)	0.3094	0.2090	0.190	-0.205	-0.234	-0.234	-0.122	-0.155	0.078	-0.132	-0.144	0.289	–		
12. Military Expenditure (% of GDP)	2.42	1.34	0.333	-0.161	-0.031	-0.153	-0.084	-0.125	-0.146	0.055	-0.013	0.589	0.599	–	
13. Arms Import[d] (log.)	18.48	1.91	0.160	-0.220	0.143	0.192	0.131	0.086	0.098	-0.121	0.244	0.257	0.045	0.027	–

Unless otherwise noted, N = 5,735
[a] N = 4,644
[b] N = 4,637
[c] N = 3,984
[d] N = 5,228

Table 4.2 Descriptive Statistics and Correlations

Country	2006				2011				2016			
	Market Ready Drones	Military Drones (% of Total)	Military Expenditure (% of GDP)	Arms Import (m. US Dollar)	Market Ready Drones	Military Drones (% of Total)	Military Expenditure (% of GDP)	Arms Import (m. US Dollar)	Market Ready Drones	Military Drones (% of Total)	Military Expenditure (% of GDP)	Arms Import (m. US Dollar)
Argentina	0	0,00	0,79	9	0	81,25	0,76	15	2	83,33	0,96	19
Australia	2	23,08	1,89	727	5	12,50	1,83	1567	20	8,82	2,00	1060
Austria	2	50,00	0,79	4	2	25,00	0,79	8	6	0	0,74	13
Belarus	0	0,00	1,71	140	0	0,00	1,22	75	5	25,00	1,27	190
Belgium	1	0,00	1,05	27	3	20,00	1,04	21	11	0,00	0,87	4
Brazil	0	0,00	1,48	179	2	0,00	1,41	312	16	9,09	1,32	125
Bulgaria	0	100,00	2,19	22	3	50,00	1,44	29	3	50,00	1,42	n/a
Canada	1	50,00	1,13	104	15	11,11	1,20	344	30	5,41	0,99	258
Chile	0	0,00	2,49	1095	2	40,00	2,25	326	4	57,14	1,87	39
China	12	100,00	2,01	2900	13	88,68	1,82	1128	124	33,18	1,92	993
Colombia	0	0,00	3,28	52	0	0,00	3,07	145	0	0,00	3,39	29
Croatia	0	33,33	1,68	n/a	0	0,00	1,78	17	0	0,00	1,37	32
Czech Republic	1	100,00	1,58	45	5	28,57	1,09	71	9	25,00	1,00	n/a
Denmark	0	0,00	1,38	83	0	0,00	1,31	n/a	1	0,00	1,15	95
Finland	0	0,00	1,32	136	1	100,00	1,37	58	2	50,00	1,36	202
France	10	61,36	2,34	67	34	33,78	2,26	33	91	7,44	2,26	45
Germany	10	90,91	1,27	416	22	37,25	1,28	84	54	17,78	1,18	38
Greece	0	0,00	2,78	731	0	50,00	2,48	80	0	66,67	2,58	318
Hungary	0	0,00	1,22	253	1	0,00	1,05	9	2	0,00	1,00	17
India	1	100,00	2,61	1520	2	85,71	2,65	3666	4	77,78	2,47	2547
Indonesia	0	0,00	0,67	65	0	0,00	0,65	250	1	85,71	0,88	382
Iran	0	100,00	3,29	423	19	47,22	2,37	100	17	44,44	2,97	374
Israel	34	94,12	7,43	1122	50	81,93	5,88	85	85	76,23	5,66	607
Italy	1	72,73	1,72	433	11	39,02	1,68	298	34	37,70	1,50	868
Japan	10	6,67	0,92	479	8	15,38	0,99	306	9	11,76	0,93	330
Jordan	0	100,00	4,66	48	0	100,00	5,53	215	0	100,00	4,58	196
Latvia	0	0,00	1,72	9	0	0,00	1,04	27	6	0,00	1,48	40
Luxembourg	0	0,00	0,58	n/a	0	0,00	0,43	n/a	0	0,00	0,50	n/a
Malaysia	1	0,00	2,01	408	0	75,00	1,57	5	1	33,33	1,41	273
Mexico	0	0,00	0,42	75	2	33,33	0,55	229	4	25,00	0,58	388
Netherlands	4	16,67	1,41	320	11	0,00	1,30	149	15	0,00	1,19	117
New Zealand	0	50,00	1,31	5	6	0,00	1,23	28	10	0,00	1,13	3
Nigeria	0	0,00	0,53	15	0	0,00	0,58	68	0	0,00	0,43	74

(table continues on next page)

	2006				2011				2016			
Country	**Market Ready Drones**	**Military Drones (% of Total)**	**Military Expenditure (% of GDP)**	**Arms Import (m. US Dollar)**	**Market Ready Drones**	**Military Drones (% of Total)**	**Military Expenditure (% of GDP)**	**Arms Import (m. US Dollar)**	**Market Ready Drones**	**Military Drones (% of Total)**	**Military Expenditure (% of GDP)**	**Arms Import (m. US Dollar)**
Norway	4	20,00	1,45	542	5	14,29	1,45	614	10	10,00	1,62	140
Pakistan	0	100,00	3,65	363	2	93,94	3,29	1088	2	95,00	3,62	759
Philippines	0	0,00	1,32	23	0	0,00	1,21	63	0	0,00	1,28	230
Poland	0	100,00	1,92	463	2	50,00	1,79	87	8	22,22	1,98	170
Portugal	0	100,00	1,95	220	3	16,67	2,00	168	11	12,50	1,84	19
Russian Federation	3	68,18	3,49	4	20	36,92	3,42	11	33	31,43	5,40	169
Singapore	4	62,50	3,95	73	5	70,00	3,24	940	6	33,33	3,35	173
Slovakia	0	0,00	1,60	n/a	0	0,00	1,08	n/a	0	0,00	1,15	n/a
Slovenia	0	100,00	1,54	3	2	66,67	1,30	28	5	30,00	0,90	n/a
South Africa	2	85,71	1,29	785	5	50,00	1,10	212	15	25,00	1,07	n/a
South Korea	5	75,00	2,49	1651	9	61,54	2,58	1574	11	48,48	2,61	1333
Spain	3	50,00	1,36	315	25	16,67	1,32	181	32	11,54	1,20	97
Sweden	0	100,00	1,33	127	2	40,00	1,12	191	7	11,11	1,03	77
Switzerland	2	25,00	0,77	83	17	7,14	0,71	32	24	3,13	0,70	4
Thailand	0	0,00	1,10	47	0	0,00	1,49	267	2	0,00	1,44	318
Turkey	1	100,00	2,42	531	4	76,19	2,08	770	6	73,68	1,71	437
Ukraine	0	100,00	2,77	n/a	0	42,86	2,26	n/a	4	18,75	3,67	n/a
United Kingdom	2	79,31	2,13	308	9	49,30	2,30	360	47	16,87	1,82	260
United States	76	63,30	3,81	641	137	55,11	4,58	995	240	30,17	3,28	512

Table 4.3 Descriptive Information on Drone Systems (Selected Years, Sample)

The largest country holding market ready drones are the United States with 79 products in 2006 growing to 240 products in 2016. More than half of all countries included in the sample did not have a single market ready product in 2006 (28 countries out of 52 countries), and only seven countries had five or more drones market ready that same year. In 2016, however, only eight countries that were not successful in bringing civil drone systems to market remained. Interestingly, Japan is the only country that reduced the number of market ready products during the observation period from ten drones in 2006 to nine drones in 2016. While a quarter of all countries exclusively had military drones in 2006, only one country (Jordan) made use exclusively of military drones in 2016. Five countries (Argentina, Chile, Finland, Greece and Indonesia) were able to grow from no military drones in 2006 to half or more of all drones present in their country being used for military purposes only. On the contrary, the Czech Republic, Poland, Ukraine, Portugal and Sweden found themselves with a reduction in their country's share of military drones by 75% or more. Israel and Jordan were the only countries with military expenditures of more than 5% of their countries' GDP in 2006 (with 7.43% and 4.66% respectively) and in 2011 (5.88% and 5.53% respectively); Russia caught up with their military expenditure in 2016 reaching 5.4% of their country's GDP. Nonetheless, also in 2016, Israel remained the country with the highest percentage of GDP spent on their military, namely 5.66%. At the beginning of the observation period, China was the largest arms importing country and spent almost 3 billion USD on importing arms, followed by South Korea (1.65 billion USD) and India (1.52 billion USD), while India is heading the list with imported arms valued at 3.67 billion USD in 2011 and 2.55 billion USD in 2016. At the same time, Chine shows the steepest decrease in arms import cutting their spending down by two-thirds to 993 million USD in 2016. Interestingly, Russia shows the highest magnitude when increasing arms import valued at 4 million USD in 2006 to 169 million USD in 2016 and Chile's spending on arms import decreased from 1.1 billion USD in 2006 to 39 million USD in 2016.

In Table 4.4, the Cox proportional hazards model regression results are reported by showing the regression coefficients and robust standard errors as well as the hazard ratios. Model I includes the general control variables, Model II includes additional, more context specific control variables and Model III-VI include the full model with the three variables for hypotheses testing added.

In Model I, we test the influence of a number of generic state variables on the market readiness of civil drones. *FDI Outflow* is a predictor of market readiness (0.033; $p < 0.001$), which indicates our assumption that export in the home country is stimulated might hold. Also, *Political Constraints* (0.664; $p < 0.01$) and *Quality of Government* (0.787; $p < 0.01$) are relevant predictors of market readiness. We can thus confirm that countries with better governmental institutions are able to leverage their innovation efforts so that they can support civil drone systems for reaching market readiness. Surprisingly, *Government Spending* (-0.009; $p < 0.05$) has a somewhat weaker, but negative effect on market readiness. Therefore, we cannot claim that larger countries are able to help civil drone systems to market readiness as the size of the country may become a liability for firms. This could be because coordination and distribution efforts of government resources increase with its size, thus making it more difficult to reach the "right" firm at the "right" time.

	Civil Drone Market Readiness											
	Model I		Model II		Model III		Model IV		Model V		Model VI	
	Coeff.[a]	HR[b]	Coeff.[a]	HR[b]	Coeff.[a]	HR[b]	Coeff.[a]	HR[b]	Coeff.[a]	HR[b]	Coeff.[a]	HR[b]
GDP	0.021 (0.024)	1.021	0.160 (0.064)**	1.173	0.189 (0.067)**	1.208	0.216 (0.071)**	1.241	0.151 (0.064)*	1.163	0.199 (0.070)**	1.220
Government Spending	-0.009 (0.004)*	0.991	-0.020 (0.005)***	0.980	-0.011 (0.005)**	0.989	-0.021 (0.005)***	0.979	-0.016 (0.005)***	0.984	-0.008 (0.005)†	0.992
Political Constraints	0.664 (0.251)**	1.942	1.694 (0.402)***	5.443	1.859 (0.400)***	6.414	1.809 (0.424)***	6.104	1.675 (0.390)***	5.340	1.877 (0.392)***	6.533
Quality of Government	0.787 (0.312)**	2.196	1.741 (0.498)***	5.703	2.509 (0.540)***	12.297	2.325 (0.544)***	10.228	1.774 (0.497)***	5.894	2.628 (0.549)***	13.845
FDI Inflow	0.003 (0.008)	1.003	0.018 (0.012)	1.018	0.015 (0.013)	1.015	0.012 (0.013)	1.012	0.016 (0.012)	1.016	0.010 (0.013)	1.010
FDI Outflow	0.033 (0.008)***	1.033	0.016 (0.012)	1.016	0.027 (0.012)†	1.027	0.023 (0.013)†	1.023	0.016 (0.012)	1.017	0.030 (0.012)*	1.030
Private R&D Expenditure			-0.001 (0.006)	0.999	0.004 (0.006)	1.004	0.005 (0.006)	1.005	0.000 (0.006)	1.000	0.007 (0.006)	1.007
Public R&D Expenditure			0.009 (0.008)	1.009	0.018 (0.007)*	1.018	0.014 (0.007)*	1.014	0.010 (0.007)	1.010	0.021 (0.007)**	1.021
New Business Entry Density			-0.034 (0.009)***	0.967	-0.034 (0.009)***	0.967	-0.039 (0.009)***	0.962	-0.037 (0.009)***	0.963	-0.041 (0.009)***	0.960
Drone Systems Total			-0.001 (0.001)	0.999	-0.002 (0.001)*	0.998	-0.002 (0.001)***	0.998	-0.001 (0.001)	0.999	-0.002 (0.001)**	0.998
Military Drones (H1)					1.962 (0.279)***	7.114					1.685 (0.299)***	5.391
Military Expenditure (H2)							0.244 (0.052)***	1.276			0.112 (0.057)*	1.118
Arms Import (H3)									0.051 (0.024)*	1.053	0.068 (0.025)**	1.071
F	30.80***		17.32***		18.81***		15.85***		16.04***		15.98***	
Average RVI	0.000		0.087		0.064		0.089		0.095		0.076	
Largest FMI	0.000		0.117		0.062		0.091		0.116		0.055	
N	3,185		3,185		3,185		3,185		3,185		3,185	

Time at risk = 11,129; n (drone systems) = 1,341; n (events) = 865

[a] Unstandardized regression coefficients are shown with robust standard errors in parentheses. [b] Hazard ratio. † p <.10 | * p <.05 | ** p < .01 | *** p < .001

Table 4..4 Cox Regression Analyses Results

In Model II, we add more specific variables to control for context-related outcomes. Of those, only *New Business Entry Density* (-0.034; $p < 0.001$) predicts market readiness of civil drone systems, but negatively. This means that a higher density of newly found businesses is not beneficial to civil drone systems becoming market ready. We explain these findings because bringing a product to market requires a certain amount of time, especially in a technology-intense context. Only firms that persist are likely to be the ones that commercialize their products. Generally speaking, a crowded start-up environment may be perceived as unattractive to enter. Therefore, more start-ups in the marketplace do not help, but rather hinder innovation efforts when it comes to civil drone market readiness. Compared to the previous model, the effect of *Government Spending* (-0.020; $p < 0.001$), *Political Constraints* (1.694; $p < 0.001$) and *Quality of Government* (1.741; $p < 0.001$) becomes stronger, and the predictive power of *FDI Outflow* (0.016; $p > 0.1$) disappears in the presence of more context-specific control variables. However, *GDP* (0.160; $p < 0.01$) positively contributes to market readiness of drone systems when context-specific controls are regarded. We explain this by positing that wealthier countries are able to enhance drone systems' market readiness when also other predictors in this regard are considered.

In Model III-V, we test hypothesis H1-H3 and present the full regression model in Model VI. Results show that all hypotheses can be confirmed. In Model III, we test the first hypothesis. Hypothesis 1 predicts that civil drone systems that are developed in a country with a high share of military drones will reach market readiness quicker. *Military Drones* (1.962; $p < 0.001$) has a positive and significant effect on civil drone market readiness. Holding all other covariates consistent, a one per cent point increase in *Military Drones* (as a percentage of total drone systems) leads to a 611.4% increase in the hazard of reaching market readiness. Compared to the previous model, we see that in the presence of *Military Drones*, *Drone Systems Total* (-0.002; $p < 0.05$) shows a significant, negative result. The mere number of

drones in a country, as *Drone Systems Total* suggests, is not contributing to more systems reaching market readiness, and the negative results suggests that it may even hinder it. Compared to the previous model and in the presence of *Military Drones*, the effect of *Government Spending* (-0.011; $p < 0.01$) on civil drone readiness becomes weaker. *FDI Outflow* (0.027; $p < 0.10$) gains in strength and becomes slightly significant as predictor. Also in the presence of *Military Drones, Public R&D Expenditure* (0.018; $p < 0.05$) becomes a significant predictor. We can explain the positive influence of governmental R&D spending by suggesting that the investments from the government in R&D will eventually benefit civil drone producers so that more systems become market ready. However, *Private R&D Expenditure* does not show an effect on civil drone market readiness in any of the models we present.

In Model IV, we test the second hypothesis. Hypothesis 2 predicts that civil drone systems that are developed in a country with high military spending will reach market readiness quicker. *Military Expenditure* (0.244; $p < 0.001$) has a positive and significant effect on civil drone market readiness. Holding all other covariates consistent, a one per cent point increase in *Military Expenditure* (as a percentage of GDP) leads to a 27.6% increase in the hazard of reaching market readiness. Compared to the previous model, we see that in the presence of *Military Expenditure, Drone Systems Total* (-0.002; $p < 0.001$) gains in strengths as a strongly significant, but again negative predictor. Our findings indicate once more that when more drone systems for all kinds of usages are present in a country, this hinders civil drone market readiness. Also *Government Spending* (-0.021; $p < 0.001$) becomes slightly more significant.

In Model V, we test the third hypothesis. Hypothesis 3 predicts that civil drone systems that are developed in a country with large military arms import will reach market readiness quicker. *Arms Import* (0.051; $p < 0.05$) has a positive and significant effect on civil drone market readiness. Holding all other covariates

consistent, a one-unit increase in *Arms Import* (as the log. of US Dollar) leads to a 5.3% increase in the hazard of reaching market readiness. Compared to the previous model, we note that *Drone Systems Total* loses its explanatory power as predictor of civil drone market readiness as does *Public R&D Expenditure* (0.010; $p > 0.1$) and *FDI Outflow* (0.016; $p > 0.1$). *GDP* becomes somewhat weaker (0.151; $p > 0.05$).

Model VI then presents the full regression model. *Military Drones* (1.685; $p > 0.001$) remains the strongest predictor of civil drone market readiness with a one per cent point increase in *Military Drones* (as a percentage of total drone systems) leading to a 439.1% increase in the hazard of reaching market readiness. Also significantly contributing to civil drone market readiness are *Military Expenditure* (0.112; $p > 0.05$) and *Arms Import* (0.068; $p > 0.01$), whereby a one per cent point increase in *Military Expenditure* (as a percentage of GDP) leads to a 11.8% increase in the hazard of reaching market readiness and a one per cent point increase in *Arms Import* (as the log. of US Dollar) leads to a 7.1% increase in the hazard of reaching market readiness.

4.4.2 Robustness Checks

We performed several robustness checks to verify that the chosen model fits our data best. To start with, we re-estimated our model with a slightly stricter measure of market readiness by considering only products as market ready if they are in inventory and/or in service as well as fully developed. This reduced the market readiness outcome measure from 3,349 to 3,301 drone-year observations, but results were not remarkably different.

Furthermore, we also used different measures for estimating governmental quality, size and military expenditure. We used *Regulatory Quality* provided by the World Bank's Worldwide Governance Indicators to measure the ability of a countries' government for comprehensive and encouraging regulations. When

replacing *Quality of Government* with *Regulatory Quality*, the magnitude and direction of results was comparable. We then used the natural logarithm of for the number of residents of a country as another measure of the size of a country. This data was taken from the World Bank. When replacing *Government Spending* with measuring the country's population, we also receive results that are comparable to our initial model in magnitude, direction and significance. Additionally, we used a measure of *Military Expenditure* as percentage of total government spending instead of GDP. This measure also showed comparable regression results with even more significant results for some variables.

To test for an alternative explanation, we approximate knowledge that was accumulated through failed products by including the total number of failed products in a given year and country (see Table 4.5). We thereby offer an organizational learning explanation, where authors find that failure contribute to learning (Argote, 2012; Baum & Dahlin, 2007; Eggers, 2012; Haunschild & Sullivan 2002; Levitt & March, 1988; Madsen & Desai, 2010). We see in Model VII (Table 4), in the absence of military explanatory variables, failed product knowledge present in a country also is a significant predictor of drone market readiness (0.011; $p < 0.001$), although with a rather small hazard ratio of 1.011. This means that one more failed drone and the associated learning experience results in a 1.1% increase in the hazard of reaching market readiness, which is rather low compared to the outcomes of H1-H3. While we find support for a learning mechanism that contributes to civil drone market readiness, we encourage future research to examine this mechanism in more detail.

We also tested the robustness of our results with alternative, parametric models similar to Jensen and Kim (2015), as they are assumed to better handle left-censoring (e.g., Allison, 2010; Gupta & Kundu, 1999; Thompson, Voit & Scott, 2000): the exponential, Weibull, Gompertz, loglogistic and lognormal survival distribution, with the exponential model showing the worst fit and the Gompertz

model showing the best fit. As the results hold, we choose to report the best interpretable, most informative model as seen in Table 4.2. This is because the Cox proportional hazards model does not assume a predetermined hazard shape, which fits our study best as we are not interested in estimating the baseline rate for market readiness (Cleves, Gould, Gutierrez & Marchenko, 2008).

Civil Drone Market Readiness		
	Model VII	
	Coeff.[a]	HR[b]
GDP	0.172 (0.064)**	1.188
Government Spending	-0.020 (0.005)***	0.980
Political Constraints	1.582 (0.404)***	4.866
Quality of Government	1.771 (0.498)***	5.878
FDI Inflow	0.0183 (0.012)	1.019
FDI Outflow	0.016 (0.012)	1.016
Private R&D Expenditure	-0.001 (0.006)	0.999
Public R&D Expenditure	0.008 (0.007)	1.008
New Business Entry Density	-0.032 (0.009)***	0.969
Drone Systems Total	-0.001 (0.001)*	0.999
Failed Products	0.011 (0.002)***	1.011
F	18.52***	
Average RVI	0.080	
Largest FMI	0.112	
N	3,185	

Time at risk = 11,129; n (drone systems) = 1,341; n (events) = 865
[a] Unstandardized regression coefficients are shown with robust standard errors in parentheses. [b] Hazard ratio. † p <.10 | * p <.05 | ** p < .01 | *** p < .001

Table 4.5 Robustness Check: Cox Regression Analyses Results with Failure Data

4.5 Discussion

4.5.1. Implications

The most promising avenue to enable market-readiness for innovative products in the civil domain is through military institutions. As we show in the case of the global

drone industry, particularly important are a high share of military drones among all systems that can be found in that country, but also increased military expenditure and investments in arms import. Interestingly, we note that even if a country has a high number of overall drone systems (and thereby accumulated drone-related knowledge and technologies), the mere high number of products is not important: it is rather the share of drones that were born out of military applications that fuels market-readiness of systems on the civil market. This points to the relevance of a supporting institution that has great influence on civil innovation, but is often overlooked in this context, namely the military.

Research on innovation systems has a long tradition in the literature on National Systems of Innovation (NSI) with its roots in economics (Freeman, 1995; Lundvall, 1992; Nelson, 1993). While the systems perspective has let scholars to draw important conclusions, for instance about countries' competitiveness (Duranton, Martin, Mayer & Mayneris, 2010; Porter, 1990) or the geography of innovation (Feldman, 1994; Feldman & Massard, 2012), we would like to shift the focus from the discussions in innovation economics – although taking institutions more seriously nowadays – to more specific, innovation-related institutions. Edquist (2001) criticized that from the conventional NSI view, the state is disregarded. Nonetheless, as other researchers pointed out, the state plays an important role in setting up innovation policy, providing investments or necessary education structures (Abbate, 1999; Mazzucato, 2013; Ruttan, 2006). Therefore, by extending the classical economical NSI view and adding insights on institutions for innovation relevant for management scholars and policy makers, we show that not only public and private civil institutions influence innovativeness, but especially military institutions are a key component for successfully helping products to market-readiness. Eventually, we may look at institutions for innovation holistically rather than single efforts driven by either the private or public sector. While early studies in economics showed that the concept of NSI proved to be valuable for explaining

economic growth decades ago (Freeman, 1995; Lundvall, 1992; Nelson, 1993), we find that there are still institutions that are overlooked and undervalued in their contribution to innovation nowadays. In the past, policy initiatives did not seem to take appropriate steps to facilitate NSI properly as this concept may be too broad, capturing only generic institutional structures. We add to existing research by stressing one type of institution particularly relevant for innovation – the military – and show that a more differentiated view is needed by considering military institutions for innovation as an important contributor to civil technology and product development.

This study's contribution is twofold. First, management scholars started to consider the unique advantages that strong military institutions may bring to either firms (Dussauge & Garrette, 1995; Hiatt et al., 2018; Hislop, 2000; Honig et al., 2006; Koch-Bayram & Wernicke, 2018). Yet, evidence regarding military institutions' benefits for a country's innovativeness is sparse (Azulay et al., 2002). This study, however, offers insights into the mechanisms of institutional support that can be leveraged from the military to the civil sector, namely through human capital spillover effects, governments' ability to encourage experimentation by investing in long-term projects with uncertain outcomes, as well as capability building. To start with, our study shows that innovative products reaching market-readiness in the civil domain can be explained through the share of military product available in that country – not by considering the complete corpus of products in that country. On the contrary, even if a country has many innovative products in all kinds of development stages and for all kinds of usage, it hinders rather than supports market-readiness; it is much more the share of products that were born out of military applications that fuels market readiness of systems on the market. This implies that between civilian firms, technological and human capital spillovers are not contributing to more successful products (and may even hinder it), but rather that spillovers from the military are the crucial factor. In line with existing studies

on technology and human capital spillovers in the military and defense industries (Acosta et al., 2011; Lerner, 1992; Niosi & Zhegu, 2005), we show that the civilian sector can profit from existing military knowledge and skills to enhance related civil products' market-readiness. With more military products being developed or market ready in a certain country, that country can utilize a higher density of knowledge and innovation from the military, which in turn can be used in civil systems. Furthermore, the military has the ability provide investments in technology and related projects that other public or private institutions are reluctant to make. While previous research tends to focus on the effect of military spending on the economy as a whole or R&D efforts in particular (Balfoussias & Stavrinos, 1996; Mowery, 1992; Yildirim & Öcal, 2016), we explicate the mechanism through which this occurs, namely invest in high-risk projects that may or may not turn out to produce successful innovation (Abbate, 1999; Leslie, 2000; Mazzucato, 2013). Surprisingly, it is neither private R&D spending nor public R&D spending that contributes to products reaching market readiness. Private R&D spending has no impact at all, which Goel and Saunoris (2018, p. 364) explain by drawing on research by Markusen, Hall, Campbell and Deitrick (1991) as well as Stephan, Uhlaner and Stride (2015), and state that "defense spending, especially defense-related R&D, is continual as opposed to private R&D which can be cyclical". Thus, without continuity, successful innovation outcomes are difficult to achieve. While the state can make certain investments on a regular and ongoing basis, the private sector might not be able to do so. Therefore, relying too much on the private sector to fuel innovation seems to be a misleading approach. Nonetheless, the contribution of public R&D spending to producing civil market ready products is small compared to the impact that military spending has. Eventually, the military supports civil product innovation by building capabilities and adjacent infrastructure that arise when countries obtain necessary technologies and innovative products through arms import. The mechanism through which arms import fosters civil innovation is driven not necessarily through the products and technologies themselves, but especially

through indirect gains arising from them. Compensation orders (Burgess & Antill, 2017; Mamadouh & Van Der Wusten, 2011) are one example through which capabilities are built and adjacent infrastructural arrangements arise in the importing country itself. Local firms, especially private ones that participate in co-development with military firms, can then utilize these capabilities and infrastructure in subsequent product development for the civil domain.

The second contribution that this study makes is by illustrating the differential ability of developed as much as developing countries to foster innovation. The potential for countries worldwide to draw from military innovation and successfully translating them to the civil domain differs significantly. We offer a novel explanation by positing that successful civil innovation depends on the extent to which countries are able to complement common public and private institutions with matching support for military products and technology. The institutional matrix (North, 1991) seems to be incomplete in many contexts when it comes to fostering innovation. Literature shows that the private sector often fails to produce innovations as initiatives are (a) lacking complementary assets (Teece, 1998; Tripsas, 1997); (b) suffering from short-term investment horizons (Bertoni & Tykvová, 2015; Cumming, 2007); (c) underinvesting in fundamental and precompetitive research (Feller, Ailes & Roessner, 2002; Niosi, Saviotti, Bellon & Crow, 1993), and (d) missing the 'translational' capacity to help products stemming from fundamental and precompetitive research become market-ready (Carayannis & Alexander, 2004; Woolf, 2008). Military institutions, however, are able to offset these shortcomings and improve the quality of the institutional matrix. As our research shows, the military is a source of human capital spillover into the civil domain, can invest in high-risk innovation projects, and builds capabilities and adjacent institutions. Thus, policy makers around the globe need to take the military-civilian symbiosis seriously as we have shown it to be an often overlooked driver of

their country's innovation capacity to support successfully leveraging military products and technology in the civil domain.

4.5.2 Limitations

We acknowledge that this study faces certain limitations that should be regarded when interpreting and discussing the results. To start with, we focused on one particular product in the defense industry, namely drones. However, there are many other products and technologies in the commercial sector that were likely to have also benefitted from military expenditure and adjacent institutions, for instance airplanes, bulldozers, nanotechnology, or Artificial Intelligence. Nonetheless, this offers a great opportunity for other researcher to take on in the future. Next, there may be issues related to the very nature of our research context. As it is usually the case with high-profile government projects, some of the initiatives we discuss are of course shrouded in secrecy, such that we can only measure our processes of interest somewhat indirectly. Still, the fact that we find so many interesting effects suggests that there is a lot more going on behind the scenes. Other researcher may be able in retrospect to examine processes that are not covered by secret government missions (anymore) and thus, can shed more light on the nature of the mechanisms in future work.

Finally, methodological issues should be pointed our as data we use is left-censored and left-truncated due to the start of our observation window in 2006. Left-censored data describes instances in which the event took place before the observation period. In our dataset, 64 drone system-year observations reached market readiness before or in 2006 and thus, were excluded. As this is a small set of observations (64 observations compared to 5,735 total observations), we have no reason to believe that there are any other unobserved events that we missed. Left-truncation occurs when the starting point of the drone system being developed is unknown (i.e. before 2006), and the systems enters at a later stage of development. To circumvent biased results and interpretations, we closely examined the data for

the first year of observation. Only 124 out of the 5,735 drone-year observations were present in our dataset in 2006, which is merely 2% of the total. Out of those, 60 systems were to be found in a pre-market readiness category, whereas 64 systems entered market ready. As these systems only represent a very small number of the total, this leads us to believe that left-censoring and left-truncation cannot have a distorting effect on the outcome.

4.6 Conclusion

Although the influence of public and private institutions for innovation has caught the interest of researcher, in many instances, truly frame-breaking innovation cannot be ascribed to those institutions. We draw the attention of management scholars to an institution they previously did not sufficiently regard, which is the military. Tested with a sample of 1,341 civil drone systems by 473 producers in 52 countries from 2006 to 2016, we can conclude that the military fosters innovation through facilitating military-driven technological and human capital spillovers, investing in high-risk innovation projects, as well as building capabilities and adjacent institutions (e.g., infrastructure). While public and private civil institutions can help bringing innovation to the market, the military is an even stronger driver for a country's innovative strength in the civil sector. Our findings can be generalized to other contexts in which countries' military institutions facilitate essential technology developments in the civil sphere. As it is the case with the rise of the Internet (born out of a military innovation) or popular mass technology such as the iPhone (utilizing a great number of inventions from the military sector), our examination of the global drone industry contributes to a better understanding of the importance of the military as an essential institution for innovation, which is generalizable to other settings in which military institutions support civil innovation.

References

Abbate, J. (1999). *Inventing the Internet*. Cambridge, MA: MIT Press.

Acemoglu, D., Johnson, S., & Robinson, J. (2005). The rise of Europe: Atlantic trade, institutional change, and economic growth. *American Economic Review,* 95, 546-579.

Acosta, M., Coronado, D., & Marín, R. (2011). Potential dual-use of military technology: Does citing patents shed light on this process? *Defence and Peace Economics,* 22, 335-349.

Acs, Z.J., & Audretsch, D.B. (2005). Entrepreneurship and innovation. *Discussion Papers on Entrepreneurship, Growth and Public Policy 2005-21,* Max Planck Institute of Economics, Group for Entrepreneurship, Growth and Public Policy.

Acs, Z.J., & Varga, A. (2005). Entrepreneurship, agglomeration and technological change. *Small Business Economics,* 24, 323-334.

Acs, Z.J., Autio, E., & Szerb, L. (2014). National systems of entrepreneurship: Measurement issues and policy implications. *Research Policy*, 43, 476-494.

Acs, Z.J., Desai, S., & Hessels, J. (2008). Entrepreneurship, economic development and institutions. *Small Business Economics,* 31, 219-234.

Ahlin, B., Drnovšek, M., & Hisrich, R.D. (2014). Entrepreneurs' creativity and firm innovation: the moderating role of entrepreneurial self-efficacy. *Small Business Economics,* 43, 101-117.

Ahlstrom, D., & Bruton, G.D. (2010). Rapid Institutional Shifts and the Co–evolution of Entrepreneurial Firms in Transition Economies. *Entrepreneurship Theory & Practice*, 34, 531-554.

Akemu, O., Whiteman, G., & Kennedy, S. (2016). Social enterprise emergence from social movement activism: The Fairphone case. *Journal of Management Studies,* 53, 846-877.

Aldrich, H.E., & Ruef, M. (2006). *Organizations Evolving*, 2nd edition. London, UK: Sage Publications.

Allison, P.D. (2004). Event history analysis. In: Hardy, M., & Bryman, A. (2009). *Handbook of Data Analysis*. Thousand Oaks, CA: Sage Publications.

Allison, P.D. (2010). Survival Analysis. In: Hancock, G.R., Mueller, R.O., & Stapleton, L.M. *The Reviewer's Guide to Quantitative Methods in the Social Sciences.* New York, NY: Routledge.

Allison, P.D. (2014). *Event History and Survival Analysis: Regression for Longitudinal Event Data*. Thousand Oaks, CA: Sage Publications.

Alsos, G.A. & Clausen, T.H. (2014). The start-up processes of tourism firms: The use of causation and effectuation strategies. In: Alsos, G.A., Eide, D. & Madsen,

E.L. (Eds.), *Handbook of Research on Innovation in Tourism Industries* (pp. 181-202). Cheltenham, UK: Edward Elgar.

Alsos, G.A., Clausen, T.H., Hytti, U., & Solvoll, S. (2016). Entrepreneurs' social identity and the preference of causal and effectual behaviors in start-up processes. *Entrepreneurship & Regional Development,* 28, 234-258.

Alvarez, S.A., & Barney, J.B. (2007). Discovery and creation: Alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal*, 1, 11-26.

Alvarez, S.A., & Busenitz, L. W. (2001). The entrepreneurship of resource-based theory. *Journal of Management*, 27, 755-775.

Ansoff, H.I. (1979). *Strategic Management.* London, UK: Macmillan.

Ansoff, H.I. (1980). Strategic issue management. *Strategic Management Journal*, 1, 131-148.

Appelhoff, D., Mauer, R., Collewaert, V., & Brettel, M. (2016). The conflict potential of the entrepreneur's decision-making style in the entrepreneur-investor relationship. *International Entrepreneurship and Management Journal,* 12, 601-623.

Arend, R.J., Sarooghi, H., & Burkemper, A.C. (2015). Effectuation as ineffectual? Applying the 3E theory-assessment framework to a proposed new theory of entrepreneurship. *Academy of Management Review*, 40, 630-651.

Arend, R.J., Sarooghi, H., & Burkemper, A.C. (2016). Effectuation, not being pragmatic or process theorizing, remains ineffectual: Responding to the commentaries. *Academy of Management Review*, 41, 549-556.

Argote, L. (2012). *Organizational Learning: Creating, Retaining and Transferring Knowledge.* New York, NY: Springer Science & Business Media.

Army Technology (2019). *Caterpillar military construction and earthmoving equipment*. Available at: https://www.army-technology.com/contractors/infrastructure/caterpillar (accessed 19-02-2019).

Asheim, B.T., & Gertler, M.S. (2005). The geography of innovation: regional innovation systems (pp. 291-317). In: Fagerberg, J., Mowery, D.C., & Nelson, R.R. *The Oxford Handbook of Innovation*. New York, NY: Oxford Press.

Audretsch, D., & Keilbach, M. (2004). Entrepreneurship capital and economic performance. *Regional Studies*, 38, 949-959.

Austin, R. (2011). *Unmanned Aircraft Systems: UAVS Design, Development and Deployment.* Sussex, UK: Wiley & Sons.

Autio, E., & Fu, K. (2015). Economic and political institutions and entry into formal and informal entrepreneurship. *Asia Pacific Journal of Management*, 32, 67-94.

Azulay, I., Lerner, M., & Tishler, A. (2002). Converting military technology through corporate entrepreneurship. *Research Policy*, 31, 419-435.

Baker, T., & Nelson, R.E. (2005). Creating something from nothing: Resource construction through entrepreneurial bricolage. *Administrative Science Quarterly*, 50, 329-366.

Baker, T., Miner, A.S., & Eesley, D.T. (2003). Improvising firms: Bricolage, account giving and improvisational competencies in the founding process. *Research Policy*, 32, 255-276.

Balfoussias, A., & Stavrinos, V. (1996). The Greek military sector and macroeconomic effects of military spending in Greece. In: Gleditsch, N.P., et al. (Eds), *The Peace Dividend* (pp. 191-213), Amsterdam, NL: Elsevier.

Barley, S.R. (1990). Images of imaging: Notes on doing longitudinal field work. *Organization Science*, 1, 220-247.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17, 99-120.

Baron, R.A., & Tang, J. (2011). The role of entrepreneurs in firm-level innovation: Joint effects of positive affect, creativity, and environmental dynamism. *Journal of Business Venturing*, 26, 49-60.

Batjargal, B., Hitt, M.A., Tsui, A.S., Arregle, J.L., Webb, J.W., & Miller, T.L. (2013). Institutional polycentrism, entrepreneurs' social networks, and new venture growth. *Academy of Management Journal*, 56, 1024-1049.

Battilana, J., & D'Aunno, T. (2009). Institutional work and the paradox of embedded agency. In: Lawrence, T. B., Suddaby, R., & Leca, B. *Institutional Work: Actors and Agency in Institutional Studies of Organizations* (pp. 31-58). Cambridge, UK: Cambridge University Press.

Baum, J.A., & Dahlin, K.B. (2007). Aspiration performance and railroads' patterns of learning from train wrecks and crashes. *Organization Science*, 18, 368-385.

Baum, J.A., & McGahan, A. (2009). *Outsourcing War: The Evolution of the Private Military Industry after the Cold War.* Working paper, University of Toronto.

Baumol, W.J. (2002). Entrepreneurship, innovation and growth: The David-Goliath symbiosis. *Journal of Entrepreneurial Finance*, 7, 1-10.

Baumol, W.J. (2010). *The Microtheory of Innovative Entrepreneurship.* New Jersey, NJ: Princeton University Press.

Belsley, D.A., Kuh, E., & Welsch, R.E. (1980). *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. New York, NY: Wiley.

Benson, J. K. (1977). Organizations: A dialectical view. *Administrative Science Quarterly*, 22, 1-21.

Berends, H., Jelinek, M., Reymen, I., & Stultiëns, R. (2014). Product innovation processes in small firms: Combining entrepreneurial effectuation and managerial causation. *Journal of Product Innovation Management*, 31, 616-635.

Berger, P.L., & Luchman, T. (1966). *The Social Construction of Reality*. New York, NY: Doubleday.

Berglund, H. (2007). Opportunities as existing and created: A study of entrepreneurs in the Swedish mobile internet industry. *Journal of Enterprising Culture*, 15, 243-273.

Bertoni, F., & Tykvová, T. (2015). Does governmental venture capital spur invention and innovation? Evidence from young European biotech companies. *Research Policy*, 44, 925-935.

Bhide, A. (1991). Bootstrap finance: The art of start-ups. *Harvard Business Review*, 70, 109-117.

Bilbao-Osorio, B., & Rodríguez-Pose, A. (2004). From R&D to innovation and economic growth in the EU. *Growth and Change*, 35, 434-455.

Bird, B. J. (1989). *Entrepreneurial behavior*. Reading, MA: Addison-Wesley.

Bisschop, P., Koopmans, C.C., Lieshout, R., Prins, J., & Volkerink, M. (2012). *Het Betere Werk. Economische Effecten van een Nieuw Gevechtsvliegtuig*. SEO-rapport nr. 2012-80.

Blank, S. (2013). Why the lean start-up changes everything. *Harvard Business Review*, 91, 63-72.

Block, F. (2008). Swimming against the current: The rise of a hidden developmental state in the United States. *Politics & Society*, 36, 169-206.

Boettke, P.J., & Coyne, C.J. (2009). Context matters: Institutions and entrepreneurship. *Foundations and Trends in Entrepreneurship*, 5, 135-209.

Bourgeois, L.J. (1985). Strategic goals, perceived uncertainty, and economic performance in volatile environments. *Academy of Management Journal*, 28, 548-573.

Boxenbaum, E. (2004). *The Emergence of a Proto-Institution*. Working Paper, Copenhagen Business School.

Bradley, S.W., & Klein, P. (2016). Institutions, economic freedom, and entrepreneurship: The contribution of management scholarship. *Academy of Management Perspectives*, 30, 211-221.

Braun, S., Friedewald, M., & Valkenburg, G. (2015). Civilizing drones–military discourses going civil? *Science & Technology Studies*, 28, 73-87.

Breschi, S., & Malerba, F., (1997). Sectoral innovation systems: technological regimes, Schumpeterian dynamics, and spatial boundaries. In: Edquist, C. *Systems of Innovation: Technologies, Institutions and Organizations* (pp. 130-156). London, UK/Washington, DC: Pinter.

Brettel, M., Mauer, R., Engelen, A., & Küpper, D. (2012). Corporate effectuation: Entrepreneurial action and its impact on R&D project performance. *Journal of Business Venturing*, 27, 167-184.

Brinckmann, J., Grichnik, D., & Kapsa, D. (2010). Should entrepreneurs plan or just storm the castle? A meta-analysis on contextual factors impacting the business planning–performance relationship in small firms. *Journal of Business Venturing*, 25, 24-40.

Brockner, J., Siegel, P.A., Daly, J.P., Tyler, T., & Martin, C. (1997). When trust matters: The moderating effect of outcome favorability. *Administrative Science Quarterly*, 42, 558-583.

Bruce, D., & Mohsin, M. (2006). Tax policy and entrepreneurship: New time series evidence. *Small Business Economics*, 26, 409-425.

Bruton, G.D., Ahlstrom, D., & Li, H.L. (2010). Institutional theory and entrepreneurship: Where are we now and where do we need to move in the future? *Entrepreneurship Theory & Practice*, 34, 421-440.

Burgess, K., & Antill, P. (2017). *Emerging strategies in defense acquisitions and military procurement.* Hershey, PA: IGI Global.

Burke, A., Fraser, S., & Greene, F.J. (2010). The multiple effects of business planning on new venture performance. *Journal of Management Studies*, 47, 391-415.

Byers, M., & Webb, S. (2011). Canada's F-35 purchase is a costly mistake. *Canadian Foreign Policy Journal*, 17, 217-227.

Bylund, P.L., & McCaffrey, M. (2017). A theory of entrepreneurship and institutional uncertainty. *Journal of Business Venturing*, 32, 461-475.

Cai, L., Guo, R., Fei, Y., & Liu, Z. (2016). Effectuation, exploratory learning and new venture performance: Evidence from China. *Journal of Small Business Management*, 55, 388-403.

Campbell, C.A. (1992). A decision theory model for entrepreneurial acts. *Entrepreneurship Theory and Practice*, 17, 21-27.

Canning, M., & O'Dwyer, B. (2016). Institutional work and regulatory change in the accounting profession. *Accounting, Organizations and Society*, 54, 1-21.

Capon, N., Farley, J.U., & Hoenig, S. (1990). Determinants of financial performance: A meta-analysis. *Management Science*, 36, 1143-1159.

Capon, N., Farley, J.U., & Hulbert, J.M. (1994). Strategic planning and financial performance: More evidence. *Journal of Management Studies*, 31, 105-110.

Carayannis, E.G., & Alexander, J. (2004). Strategy, structure, and performance issues of precompetitive R&D consortia: insights and lessons learned from SEMATECH. *IEEE Transactions on Engineering Management*, 51, 226-232.

Castrogiovanni, G.J. (1996). Pre-startup planning and the survival of new small businesses: Theoretical linkages. *Journal of Management*, 22, 801-822.

Chandler, G.N. & Lyon, D.W. (2001, August). Entrepreneurial teams in new ventures: Composition, turnover and performance. *Academy of Management Conference Proceedings*, Washington D.C.

Chandler, G.N., DeTienne, D.R., McKelvie, A., & Mumford, T.V. (2011). Causation and effectuation processes: A validation study. *Journal of Business Venturing*, 26, 375-390.

Chang, S.J., Van Witteloostuijn, A., & Eden, L. (2010). From the editors: Common method variance in international business research. *Journal of International Business Studies*, 41, 178-184.

Charmaz, K. (2014). *Constructing grounded theory*. Thousand Oaks, CA: Sage.

Cheung, K.Y., & Ping, L. (2004). Spillover effects of FDI on innovation in China: Evidence from the provincial data. *China Economic Review*, 15, 25-44.

Chwolka, A., & Raith, M.G. (2012). The value of business planning before start-up–A decision-theoretical perspective. *Journal of Business Venturing*, 27, 385-399.

Cleves, M., Gould, W., Gutierrez, R., & Marchenko, Y. (2008). *An Introduction to Survival Analysis Using Stata*. Texas, TX: Stata Press.

Cohen, B., & Winn, M.I. (2007). Market imperfections, opportunity and sustainable entrepreneurship. *Journal of Business Venturing*, 22, 29-49.

Conway, J.M., & Lance, C.E. (2010). What reviewers should expect from authors regarding common method bias in organizational research. *Journal of Business and Psychology*, 25, 325-334.

Cooke, P., Uranga, M.G., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. *Research Policy*, 26, 475-491.

Copeland, R., Francia, A., & Strawser, R. (1973). Students as subjects in behavioral research. *Accounting Review*, 48, 365-372.

Coriat, B., & Weinstein, O. (2002). Organizations, firms and institutions in the generation of innovation. *Research Policy*, 31, 273-290.

Cowan, R., & Foray, D. (1995). Quandaries in the economics of dual technologies and spillovers from military to civilian research and development. *Research Policy*, 24, 851-868.

Cowling, M., & Taylor, M. (2001). Entrepreneurial women and men: Two different species? *Small Business Economics*, 16, 167-175.

Cox, D. R. (1972). Regression models and life-tables. *Journal of the Royal Statistical Society: Series B (Methodological)*, 34, 187-202.

Cumming, D. (2007). Government policy towards entrepreneurial finance: Innovation investment funds. *Journal of Business Venturing*, 22, 193-235.

Dakhli, M., & De Clercq, D. (2004). Human capital, social capital, and innovation: A multi-country study. *Entrepreneurship & Regional Development*, 16, 107-128.

Dalamagkidis, K., Valavanis, K.P., & Piegl, L.A. (2012). *On integrating unmanned aircraft systems into the national airspace system: issues, challenges, operational restrictions, certification, and recommendations. Intelligent Systems, Control and Automation: Science and Engineering.* New York, NY: Springer.

Daniel, E.M., Di Domenico, M., & Sharma, S. (2014). Effectuation and home-based online business entrepreneurs. *International Small Business Journal*, 33, 799-823.

David, P.A., Hall, B.H., & Toole, A.A. (2000). Is public R&D a complement or substitute for private R&D? A review of the econometric evidence. *Research Policy*, 29, 497-529.

De Clercq, D., & Bosma, N. (2008). An exploratory study of international commitment by nascent and existing firms. *Journal of Small Business and Entrepreneurship*, 21, 223-237.

De Silva, A.P., Moreno-Betancur, M., De Livera, A.M., Lee, K.J., & Simpson, J.A. (2017). A comparison of multiple imputation methods for handling missing values in longitudinal data in the presence of a time-varying covariate with a non-linear association with time: A simulation study. BMC Medical Research Methodology, 17, 114-124.

Decker, R., Haltiwanger, J., Jarmin, R., & Miranda, J. (2014). The role of entrepreneurship in US job creation and economic dynamism. *Journal of Economic Perspectives*, 28, 3-24.

Delbridge, R., & Edwards, T. (2008). Challenging conventions: Roles and processes during non-isomorphic institutional change. *Human Relations*, 61, 299-325.

Deligianni, I., Voudouris, I., & Lioukas, S. (2015). Do effectuation processes shape the relationship between product diversification and performance in new ventures? *Entrepreneurship Theory & Practice*, 41, 349-377.

Delmar, F., & Shane, S. (2003). Does business planning facilitate the development of new ventures? *Strategic Management Journal*, 24, 1165-1185.

Delmar, F., & Shane, S. (2004). Legitimating first: Organizing activities and the survival of new ventures. *Journal of Business Venturing*, 19, 385-410.

Dess, G.G., & Robinson, R.B. (1984). Measuring organizational performance in the absence of objective measures: The case of the privately-held firm and conglomerate business unit. *Strategic Management Journal*, 5, 265-273.

DeTienne, D.R., McKelvie, A., & Chandler, G.N. (2015). Making sense of entrepreneurial exit strategies: A typology and test. *Journal of Business Venturing*, 30, 255-272.

Dew, N., Read, S., Sarasvathy, S.D. & Wiltbank, R. (2009). Effectual versus predictive logics in entrepreneurial decision-making: Differences between experts and novices. *Journal of Business Venturing*, 24, 287-309.

Dew, N., Read, S., Sarasvathy, S.D., & Wiltbank, R. (2015). Entrepreneurial expertise and the use of control. *Journal of Business Venturing Insights*, 4, 30-37.

Dew, N., Sarasvathy, S.D., Read, S., & Wiltbank, R. (2009). Affordable loss: Behavioral economic aspects of the plunge decision. *Strategic Entrepreneurship Journal*, 3, 105-126.

DiMaggio, P.J. (1988). Interest and agency in institutional theory. In: Zucker, L.G., *Institutional patterns and organizations* (pp. 3-22). Cambridge, MA: Ballinger.

Djankov, S., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2002). The regulation of entry. *Quarterly Journal of Economics*, 117, 1-37.

Dorado, S., & Ventresca, M.J. (2013). Crescive entrepreneurship in complex social problems: Institutional conditions for entrepreneurial engagement. *Journal of Business Venturing*, 28, 69-82.

Douhan, R., & Henrekson, M. (2007). The political economy of entrepreneurship: An introduction. In: Henrekson, M., & Douhan, R., *International Library of Entrepreneurship Series: The Political Economy of Entrepreneurship*. Northampton, UK: Edward Elgar.

Du Rietz, A., & Henrekson, M. (2000). Testing the female underperformance hypothesis. *Small Business Economics*, 14, 1-10.

Duchesneau, D.A. & Gartner, W.B. (1990). A profile of new venture success and failure in an emerging industry. *Journal of Business Venturing*, 5, 297-312.

Duranton, G., Martin, P., Mayer, T., & Mayneris, F. (2010). *The Economics of Clusters*. New York, NY: Oxford University Press.

Dussauge, P., & Garrette, B. (1995). Determinants of success in international strategic alliances: Evidence from the global aerospace industry. *Journal of International Business Studies*, 26, 505-530.

Dutch House of Representatives (2015). *Minutes of Committee Meeting Drones. Tweede Kamer der Staten-Generaal, Onbemande Vliegtuigen (UAV), 30 806, no. 32*. Available at: https://zoek.officielebekendmakingen.nl/kst-30806-39.html (accessed 25-10-2018).

Dutton, J.E., & Ottensmeyer, E. (1987). Strategic issue management systems: Forms, functions, and contexts. *Academy of Management Review*, 12, 355-365.

Eddleston, K.A., Kellermanns, F.W., Sarathy, R. (2008). Resource configuration in family firms: Linking resources, strategic planning and technological opportunities to performance. *Journal of Management Studies*, 45, 26-50.

Edquist, C. (2001). *The systems of innovation approach and innovation policy: An account of the state of the art*. Lead Paper Presented at the DRUID Conference, June 12-15, Aalborg.

Eggers, J.P. (2012). Falling flat: Failed technologies and investment under uncertainty. *Administrative Science Quarterly*, 57, 47-80.

Eisenhardt, K., & Schoonhoven, C. (1996). Resource-based view of strategic alliance formation: Strategic and social effects in entrepreneurial firms. *Organizational Science*, 7, 136-150.

Elert, N., Henrekson, M., & Wernberg, J. (2016). Two sides to the evasion: The Pirate Bay and the interdependencies of evasive entrepreneurship. *Journal of Entrepreneurship and Public Policy*, 5, 176-200.

Eliasson, G. (2011). Advanced purchasing, spillovers and innovative discovery. *Journal of Evolutionary Economics*, 21, 121-139.

Engel, Y., Dimitrova, N.G., Khapova, S.N., & Elfring, T. (2014). Uncertain but able: Entrepreneurial self-efficacy and novices′ use of expert decision-logic under uncertainty. *Journal of Business Venturing Insights*, 1, 12-17.

Estrin, S., Korosteleva, J., & Mickiewicz, T. (2013). Which institutions encourage entrepreneurial growth aspirations? *Journal of Business Venturing*, 28, 564-580.

European Commission (2013). *Entrepreneurship 2020 Action Plan*, COM (2012) 795 final.

European Commission (2015). *Report on safe use of remotely piloted aircraft systems (RPAS), commonly known as unmanned aerial vehicles (UAVs), in the field of civil aviation, (2014/2243(INI))*. Available at: http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A8-2015-0261+0+DOC+XML+V0//EN (accessed 25-10-2018).

Evald, M.R., & Senderovitz, M. (2013). Exploring internal corporate venturing in SMEs: Effectuation at work in a new context**.** *Journal of Enterprising Culture, 21*, 275-299.

Evers, N., & O'Gorman, C. (2011). Improvised internationalization in new ventures: The role of prior knowledge and networks. *Entrepreneurship & Regional Development*, 23, 549-574.

Fairlie, R. W., & Robb, A. M. (2009). Gender differences in business performance: evidence from the Characteristics of Business Owners survey. *Small Business Economics*, 33, 375-395.

Feldman, M.P. (1994). *The Geography of Innovation*. New York, NY: Springer Science & Business Media.

Feldman, M.P. (1999). The new economics of innovation, spillovers and agglomeration: A review of empirical studies. *Economics of Innovation and New Technology*, 8, 5-25.

Feldman, M.P. (2014). The character of innovative places: entrepreneurial strategy, economic development, and prosperity. *Small Business Economics*, 43, 9-20.

Feldman, M.P., & Massard, N. (2012). *Institutions and systems in the geography of innovation*. New York, NY: Springer Science & Business Media.

Feller, I., Ailes, C.P., & Roessner, J.D. (2002). Impacts of research universities on technological innovation in industry: Evidence from engineering research centers. *Research Policy*, 31 457-474.

Filippetti, A., & Archibugi, D. (2011). Innovation in times of crisis: National Systems of Innovation, structure, and demand. *Research Policy*, 40, 179-192.

Fischer, E., & Reuber, A.R. (2011). Social interaction via new social media: (How) can interactions on Twitter affect effectual thinking and behavior? *Journal of Business Venturing*, 26, 1-18.

Fisher, G. (2012). Effectuation, causation, and bricolage: A behavioral comparison of emerging theories in entrepreneurship research. *Entrepreneurship Theory & Practice*, 36, 1019-1051.

Fisher, G., Kotha, S., & Lahiri, A. (2016). Changing with the times: An integrated view of identity, legitimacy and new venture life cycles. *Academy of Management Review*, 41, 383-409.

Fligstein, N. (1997). Social skill and institutional theory. *American Behavioral Scientist*, 40, 397-405.

Fligstein, N. (2001). Social skill and the theory of fields. *Sociological Theory*, 19, 105-125.

Fölster, S. (2000). Do entrepreneurs create jobs? *Small Business Economics*, 14, 137-148.

Forbes, D.P., & Kirsch, D.A. (2011). The study of emerging industries: Recognizing and responding to some central problems. *Journal of Business Venturing*, 26, 589-602.

Freeman, C. (1995). The 'National System of Innovation' in historical perspective. *Cambridge Journal of Economics*, 19, 5-24.

Frese, M. (2009). Toward a psychology of entrepreneurship: An action theory perspective. *Foundations and Trends in Entrepreneurship*, 5, 437-496.

Frese, M., & Gielnik, M.M. (2014). The psychology of entrepreneurship. *Annual Review of Organizational Psychology and Organizational Behavior*, 1, 413-438.

Frese, M., Krauss, S.I., Keith, N., Escher, S., Grabarkiewicz, R., Luneng, S.T., et al. (2007). Business owners' action planning and its relationship to business success in three African countries. *Journal of Applied Psychology*, 92, 1481-1498.

Frese, T., Geiger, I., & Dost, F. (2019). An empirical investigation of determinants of effectual and causal decision logics in online and high-tech start-up firms. *Small Business Economics*, 1-24.

Friedman, M. (1953). *Essays in positive economics.* Chicago, IL: University of Chicago Press.

Furman, J.L., Porter, M.E., & Stern, S. (2002). The determinants of national innovative capacity. *Research Policy*, 31, 899-933.

Galindo, M.Á., & Méndez, M.T. (2014). Entrepreneurship, economic growth, and innovation: Are feedback effects at work? *Journal of Business Research*, 67, 825-829.

Garud, R., & Gehman, J. (2016). Theory evaluation, entrepreneurial processes, and performativity. *Academy of Management Review*, 41, 544-549.

Garud, R., Jain, S., & Kumaraswamy, A. (2002). Institutional entrepreneurship in the sponsorship of common technological standards: The case of Sun Microsystems and Java. *Academy of Management Journal*, 45, 196-214.

Gentry, W., & Hubbard, G. (2000). Tax policy and entrepreneurial entry. *The American Economic Review*, 90, 283-287.

George, G. (2005). Slack resources and the performance of privately held firms. *Academy of Management Journal*, 48, 661-676.

Giannetti, M., & Simonov, A. (2004). On the determinants of entrepreneurial activity: Social norms, economic environment and individual characteristics. *Swedish Economic Policy Review*, 11, 269-313.

Gielnik, M.M., & Frese M. (2013). Entrepreneurship and poverty reduction: applying I-O psychology to micro-business and entrepreneurship in developing countries. In Olson-Buchanan, J.B., Koppes Bryan, L.L. & Foster Thompson, L. (Eds.), *Using industrial-organizational psychology for the greater good: Helping those who help others* (pp. 394-438). New York, NY: Routledge.

Gimeno, J., Folta, T.B., Cooper, A.C. & Woo, C.Y. (1997). Survival of the fittest? Entrepreneurial human capital and the persistence of underperforming firms. *Administrative Science Quarterly*, 42, 750-783.

Gioia, D.A., Corley, K.G., & Hamilton, A.L. (2013). Seeking qualitative rigor in inductive research notes on the Gioia methodology. *Organizational Research Methods*, 16, 15-31.

Global Security (2018). *F-35 Joint Strike Fighter*. Accessed on 21-12-2018 (https://www.globalsecurity.org/military/world/europe/nl-f-35.htm)

Goel, R.K., & Saunoris, J.W. (2018). Military spending and entrepreneurship: Spatial effects of cross-country spillovers. *Managerial and Decision Economics*, 39, 363-373.

Greenwood, R., & Suddaby, R. (2006). Institutional entrepreneurship in mature fields: The big five accounting firms. *Academy of Management Journal*, 49, 27-48.

Gregory, D. (2011). From a view to a kill: Drones and late modern war. *Theory, Culture & Society*, 28, 188-215.

Gruber, M. (2007). Uncovering the value of planning in new venture creation: A process and contingency perspective. *Journal of Business Venturing*, 22, 782-807.

Gupta, R.D., & Kundu, D. (1999). Theory & methods: Generalized exponential distributions. *Australian & New Zealand Journal of Statistics*, 41, 173-188.

Gupta, V.K., Chiles, T.H., & McMullen, J.S. (2016). A process perspective on evaluating and conducting effectual entrepreneurship research. *Academy of Management Review*, 41, 540-544.

Hair, J., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate data analysis*. Upper Saddle River, NJ: Prentice-Hall.

Hargadon, A.B., & Douglas, Y. (2001). When innovations meet institutions: Edison and the design of the electric light. *Administrative Science Quarterly*, 46, 476-501.

Hargrave, T.J., & Van de Ven, A.H. (2006). A collective action model of institutional innovation. *Academy of Management Review*, 31, 864-888.

Harman, H.H. (1967). *Modern Factor Analysis.* Chicago, IL: University of Chicago Press.

Harmeling, S. (2011). Contingency as an entrepreneurial resource: How private obsession fulfills public need. *Journal of Business Venturing*, 26, 293-305.

Harms, R., & Schiele, H. (2012). Antecedents and consequences of effectuation and causation in the international new venture creation process. *Journal of International Entrepreneurship*, 10, 95-116.

Harrison, R.T., Mason, C.M., & Girling, P. (2004). Financial bootstrapping and venture development in the software industry. *Entrepreneurship & Regional Development*, 16, 307-333.

Hart, D.M. (2003). *The Emergence of Entrepreneurship Policy: Governance, Start-ups, and Growth in the U.S. Knowledge Economy.* Cambridge, MA: Cambridge University Press.

Haunschild, P.R., & Sullivan, B.N. (2002). Learning from complexity: Effects of prior accidents and incidents on airlines' learning. *Administrative Science Quarterly*, 47, 609-643.

Hauser, A., Eggers, F., & Güldenberg, S. (2019). Strategic decision-making in SMEs: effectuation, causation and the absence of strategy. *Small Business Economics*, 1-16.

Helfen, M., & Sydow, J. (2013). Negotiating as institutional work: The case of labour standards and international framework agreements. *Organization Studies*, 34, 1073-1098.

Henrekson, M., & Sanandaji, T. (2011). The interaction of entrepreneurship and institutions. *Journal of Institutional Economics*, 7, 47-75.

Hensel, P.G. (2018). Organizational responses to proto-institutions: How the semi-edited and unedited accounts clash. *Journal of Management Inquiry*, 27, 224-245.

Hiatt, S.R., Carlos, W.C., & Sine, W.D. (2018). Manu Militari: The institutional contingencies of stakeholder relationships on entrepreneurial performance. *Organization Science*, 29, 633-652.

Hislop, D. (2000). Environmental constraints and sectoral recipes: Strategy change in Britain's military industrial base. *Journal of Management Studies*, 37, 687-703.

Hitt, M. A., Keats, B. W., & DeMarie, S. M. (1998). Navigating in the new competitive landscape: Building strategic flexibility and competitive advantage in the 21st century. *Academy of Management Executive, 12*, 22-42.

Hmieleski, K.M., & Corbett, A.C. (2008). The contrasting interaction effects of improvisational behavior with entrepreneurial self-efficacy on new venture performance and entrepreneur work satisfaction. *Journal of Business Venturing*, 23, 482-496.

HOLT CAT (2019). *A heritage of innovation*. Available at: https://www.holtcat.com/about_us/a_heritage_of_innovation.aspx (accessed on 19-02-2019).

Honig, B. (2004). Entrepreneurship education: Toward a model of contingency-based business planning. *Academy of Management Learning & Education*, 3, 258-273.

Honig, B., & Samuelsson, M. (2014). Data replication and extension: A study of business planning and venture-level performance. *Journal of Business Venturing Insights*, 1, 18-25.

Honig, B., Lerner, M., & Raban, Y. (2006). Social capital and the linkages of high-tech companies to the military defense system: Is there a signaling mechanism? *Small Business Economics*, 27, 419-437.

Horwitz, S.K., & Horwitz, I.B. (2007). The effects of team diversity on team outcomes: A meta-analytic review of team demography. *Journal of Management*, 33, 987-1015.

Institute of Defense Analyses (2010). *WSARA 2009: Joint Strike Fighter Root Cause Analysis* (No. IDA/HQ-P-4612).

International Civil Aviation Organization (2011). *Unmanned Aircraft Systems (UAS), Circular: UAS 328. Cir 328 AN/190. Montreal, CA: ICAO*. Available at: https://www.icao.int/Meetings/UAS/Documents/Circular%20328_en.pdf (accessed 25-10-2018).

Jacobides, M.J., Knudsen, T., & Augier, M. (2006). Benefiting from innovation: Value creation, value appropriation and the role of industry architectures. *Research Policy*, 35, 1200-1216.

Jensen, M., & Kim, H. (2015). The real Oscar curse: The negative consequences of positive status shifts. *Organization Science*, 26, 1-21.

Jones, K. (2007). Entrepreneurs in the global economy. In: Minniti, M. (Ed.), *Entrepreneurship: The Engine of Growth*, (pp. 136–153). Westport, CT: Praeger Press-Greenwood Publishing Group.

Keller, W. (2010). International trade, foreign direct investment, and technology spillovers. In: Hall, B. H., & Rosenberg, N. *Handbook of the Economics of Innovation* (pp. 793-829). Amsterdam, NL: North-Holland, Elsevier.

Khoja, F. & Lutafali, S. (2008). Micro-financing: An innovative application of social networking. *Ivey Business Journal*, 72, 1-9.

Klepper, S., & Graddy, E. (1990). The evolution of new industries and the determinants of market structure. *The RAND Journal of Economics*, 21, 27-44.

Koch-Bayram, I.F., & Wernicke, G. (2018). Drilled to obey? Ex-military CEOs and financial misconduct. *Strategic Management Journal*, 39, 2943-2964.

Kristinsson, K., Candi, M., & Sæmundsson, R.J. (2016). The relationship between founder team diversity and innovation performance: The moderating role of causation logic. *Long Range Planning*, 49, 464-476.

Krueger, N.F., Jr., Reilly, M.D., & Carsrud, A.L. (2000). Competing models of entrepreneurial intentions. *Journal of Business Venturing*, 15, 411-432.

Kuznets, S. (1973). Modern economic growth: Findings and reflections. *The American Economic Review*, 63, 247-258.

Langley, A. (1999). Strategies for theorizing from process data. *Academy of Management Review*, 24, 691-710.

Langley, A., & Abdallah, C. (2011). Templates and turns in qualitative studies of strategy and management. *Research Methodology in Strategy and Management*, 6, 201-235.

Langley, A., Smallman, C., Tsoukas, H., & Van de Ven, A.H. (2013). Process studies of change in organization and management: Unveiling temporality, activity, and flow. *Academy of Management Journal*, 56, 1-13.

Langley, D.J., Pals, N., & Ortt, J.R. (2005). Adoption of behavior: Predicting success for major innovations. *European Journal of Innovation Management*, 8, 56-78.

Lanivich, S.E. (2015). The RICH entrepreneur: Using conservation of resources theory in contexts of uncertainty. *Entrepreneurship Theory & Practice*, 39, 863-894.

Laskovaia, A., Marino, L., Shirokova, G., & Wales, W. (2018). Expect the unexpected: examining the shaping role of entrepreneurial orientation on causal and effectual decision-making logic during economic crisis. *Entrepreneurship & Regional Development*, 1-20.

Lawrence, T.B., & Suddaby R. (2006). Institutions and institutional work. In: Clegg S. R., Hardy C., Lawrence T.B., & Nord W.R. (Eds.), *Handbook of Organization Studies, 2nd Ed.* (pp. 215-254). London, UK: Sage.

Lawrence, T.B., Hardy, C., & Phillips, N. (2002). Institutional effects of interorganizational collaboration: The emergence of proto-institutions. *Academy of Management Journal*, 45, 281-290.

Lawrence, T.B., Suddaby, R., & Leca, B. (2009). *Institutional Work: Actors and Agency in Institutional Studies of Organizations*. Cambridge, UK: Cambridge University Press.

Lawrence, T.B., Suddaby, R., & Leca, B. (2011). Institutional work: Refocusing institutional studies of organization. *Journal of Management Inquiry*, 20, 52-58.

Leblebici, H., Salancik G.R., Copay A., & King T. (1991). Institutional change and the transformation of inter-organizational fields: An organizational history of the US radio broadcasting industry. *Administrative Science Quarterly*, 36, 333-363.

Lee, D.Y., & Tsang, E.W.K. (2001). The effects of entrepreneurial personality, background and network activities on venture growth. *Journal of Management Studies*, 38, 583-602.

Leonard-Barton, D. (1995). Wellsprings of knowledge: Building and sustaining the sources of innovation. *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*. Available at SSRN: https://ssrn.com/abstract=1496178

Lerner, J. (1992). The mobility of corporate scientists and engineers between civil and defense activities: Implications for economic competitiveness in the post-cold war era. *Defence and Peace Economics*, 3, 229-242.

Leslie, S. (2000). The biggest "angel" of them all: The military and the making. In: Kenny, M. (Ed.), *Understanding Silicon Valley: The Anatomy of an Entrepreneurial Region*, (pp. 48-70). Stanford, CA: Stanford University Press.

Levitt, B., & March, J.G. (1988). Organizational learning. *Annual Review of Sociology*, 14, 319-338.

Li, W. (2002). Entrepreneurship and government subsidies: A general equilibrium analysis. *Journal of Economic Dynamics & Control*, 26, 1815-1844.

Lim, D.S., Morse, E.A., Mitchell, R.K., & Seawright, K.K. (2010). Institutional environment and entrepreneurial cognitions: A comparative business systems perspective. *Entrepreneurship Theory & Practice*, 34, 491-516.

Lipsey, R.E. (2004). Home-and host-country effects of foreign direct investment. In Baldwin, R.E. & Winters, L.A. (Eds.), *Challenges to Globalization: Analyzing the Economics* (pp. 333-382). Chicago, IL: University of Chicago Press.

Love, L.G., Priem, R.L., & Lumpkin, G.T. (2002). Explicitly articulated strategy and firm performance under alternative levels of centralization. *Journal of Management*, 28, 611-627.

Lundstrom, A., & Stevenson, L. (2005). *Entrepreneurship Policy: Theory and Practice.* Boston, MA: Kluwer Academic Publishers.

Lundvall, B.A. (1992). *National innovation system: Towards a theory of innovation and interactive learning*. London, UK: Pinter Publishers.

Lynn, L.H., Reddy, N.M., & Aram, J.D. (1996). Linking technology and institutions: The innovation community framework. *Research Policy*, 25, 91-106.

Madsen, P.M., & Desai, V. (2010). Failing to learn? The effects of failure and success on organizational learning in the global orbital launch vehicle industry. *Academy of Management Journal*, 53, 451-476.

Maguire, S., Hardy, C., & Lawrence, T.B. (2004). Institutional entrepreneurship in emerging fields: HIV/AIDS treatment advocacy in Canada. *Academy of Management Journal*, 47, 657-679.

Maine, E., Soh, P.H., & Dos Santos, N. (2015). The role of entrepreneurial decision-making in opportunity creation and recognition. *Technovation*, 39, 53-72.

Malchow-Møller, N., Schjerning, B., & Sørensen, A. (2011). Entrepreneurship, job creation and wage growth. *Small Business Economics*, 36, 15-32.

Malerba, F., 2002. Sectoral systems of innovation. *Research Policy*, 31, 247-264.

Mamadouh, V., & van der Wusten, H. (2011). The footprint of the JSF/F-35 Lightning II military jet in the Netherlands: geopolitical and geo-economic considerations in arms procurement and arms production. *L'Espace Politique*, 15, 1-20.

Mansoori, Y., & Lackéus, M. (2019). Comparing effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, lean startup, and design thinking. *Small Business Economics*, 1-28.

Marcin, K. (2008). How does FDI inflow affect productivity of domestic firms? The role of horizontal and vertical spillovers, absorptive capacity and competition. *The Journal of International Trade & Economic Development*, 17, 155-173.

Markusen, A.R., Deitrick, S., Campbell, S., & Hall, P. (1991). The rise of the gunbelt: The military remapping of industrial America. Oxford, UK and New York, NY: Oxford University Press.

Marti, I., & Mair, J. (2009). Bringing change into the lives of the poor: Entrepreneurship outside traditional boundaries. In: Lawrence, T. B., Suddaby, R., & Leca, B., *Institutional Work: Actors and Agency in Institutional Studies of Organizations* (pp. 92-119). Cambridge, UK: Cambridge University Press.

Marvel, M.R., & Lumpkin, G.T. (2007). Technology entrepreneurs' human capital and its effects on innovation radicalness. *Entrepreneurship Theory & Practice*, 31, 807-828.

Mayer-Haug, K., Read, S., Brinckmann, J., Dew, N., & Grichnik, D. (2013). Entrepreneurial talent and venture performance: A meta-analytic investigation of SMEs. *Research Policy*, 42, 1251-1273.

Maznevski, M.L. (1994). Understanding our differences: Performance in decision-making groups with diverse members. *Human Relations*, 47, 531-552.

Mazzucato, M. (2013). *The entrepreneurial state: Debunking the public vs. private myth in risk and innovation.* London, UK: Anthem.

McBride, P. (2009). Beyond Orwell: The application of Unmanned Aircraft Systems in domestic surveillance operations. *Journal of Air Law and Commerce*, 74, 627-662.

McDonald, B.D. (2013). What we do and do not know: The social implications of defense. *Political and Military Sociology: An Annual Review*, 41, 1-18.

McKelvie, A., Chandler, G.N., DeTienne, D.R., & Johansson, A. (2019). The measurement of effectuation: highlighting research tensions and opportunities for the future. *Small Business Economics*, 1-32.

McKelvie, A., DeTienne, D.R., & Chandler, G.N. (2013). What is the appropriate dependent variable in effectuation research? *Frontiers of Entrepreneurship Research,* 33, 4.

McMullen, J.S., & Dimov, D. (2013). Time and the entrepreneurial journey: the problems and promise of studying entrepreneurship as a process. *Journal of Management Studies*, 50, 1481-1512.

Meyer, J.P., Stanley, D.J., Herscovitch, L., & Topolnytsky, L. (2002). Affective, continuance, and normative commitment to the organization: A meta-analysis of antecedents, correlates, and consequences. *Journal of Vocational Behavior*, 61, 20-52.

Miller, C.C., & Cardinal, L.B. (1994). Strategic planning and firm performance: A synthesis of more than two decades of research. *Academy of Management Journal,* 37, 1649-1665.

Miner, A., Bassoff, P., & Moorman, C. (2001). Organizational improvisation and learning: A field study. *Administrative Science Quarterly*, 46, 304-337.

Minniti, M. (2008). The role of government policy on entrepreneurial activity: productive, unproductive, or destructive? *Entrepreneurship Theory & Practice*, 32, 779-790.

Mintrom, M. (1997). Policy entrepreneurs and the diffusion of innovation. *American Journal of Political Science*, 738-770.

Mintzberg H., & Westley F. (2001). Decision making: It's not what you think. *Sloan Management Review*, 42, 89-93.

Mintzberg, H. (1978). Patterns in strategy formation. *Management Science,* 24, 934-948.

Molas-Gallart, J. (1997). Which way to go? Defence technology and the diversity of 'dual-use' technology transfer. *Research Policy*, 26, 367-385.

Mowery, D.C. (1992). The US national innovation system: Origins and prospects for change. *Research Policy*, 21, 125-144.

Mthanti, T.S., & Urban, B. (2014). Effectuation and entrepreneurial orientation in high-technology firms. *Technology Analysis & Strategic Management*, 26, 121-133.

Nadkarni, S., & Narayanan, V.K. (2007). Strategic schemas, strategic flexibility, and firm performance: the moderating role of industry clockspeed. *Strategic Management Journal*, 28, 243-270.

National Mining Association (2019). *Caterpillar: Engineering equipment to protect our military.* Available at: https://nma.org/2017/10/10/caterpillar-engineering-equipment-protect-military (accessed 19-02-2019).

Navis, C., & Glynn, M.A. (2010). How new market categories emerge: Temporal dynamics of legitimacy, identity, and entrepreneurship in satellite radio, 1990–2005. *Administrative Science Quarterly*, 55, 439-471.

Neck, H.M., & Greene, P.G. (2011). Entrepreneurship education: Known worlds and new frontiers. *Journal of Small Business Management*, 49, 55-70.

Nelson, A.J. (2014). From the ivory tower to the startup garage: Organizational context and commercialization processes. *Research Policy*, 43, 1144-1156.

Nelson, R. (1993). *National innovation systems: A comparative analysis*. Oxford, UK and New York, NY: Oxford University Press.

Nelson, R. (2002). Technology, institutions, and innovation systems. *Research Policy*, 31, 265-272.

Neter, J., Wasserman W., & Kutner, M.H. (1990). *Applied linear statistical models*. Chicago, IL: Irwin.

Niosi, J., & Zhegu, M. (2005). Aerospace clusters: local or global knowledge spillovers? *Industry & Innovation*, 12, 5-29.

Niosi, J., Saviotti, P., Bellon, B., & Crow, M. (1993). National systems of innovation: in search of a workable concept. *Technology in Society*, 15, 207-227.

Nooteboom, B. (2000). Institutions and forms of co-ordination in innovation systems. *Organization Studies*, 21, 915-939.

North, D.C. (1991). Institutions. *Journal of Economic Perspectives*, 5, 97-112.

Nummela, N., Saarenketo, S., Jokela, P., & Loane, S. (2014). Strategic decision-making of a born global: A comparative study from three small open economies. *Management International Review*, 54, 527-550.

Nunnally, J.C. (1978). *Psychometric theory.* New York, NY: McGraw-Hill.

O'Brien, R.M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*, 41, 673-690.

Oliver, C. (1991). Strategic responses to institutional processes. *Academy of Management Review*, 16, 145-179.

Organisation for Economic Co-operation and Development (2019). *Cultivating successful entrepreneurs.* Available at: http://www.oecd.org/cfe/leed/entrepreneurship.htm (accessed 28-02-2019).

Ozcan, P., & Gurses, K. (2018). Playing cat and mouse: Contests over regulatory categorization of dietary supplements in the U.S. *Academy of Management Journal*, 61, 1789-1820.

Padgett, J.F., & Powell, W.W. (2012). *The emergence of organizations and markets*. Princeton, NJ: Princeton University Press.

Palme, O. (1982). Military spending: The economic and social consequences. *Challenge*, 25, 4-21.

Park, J.S. (2005). Opportunity recognition and product innovation in entrepreneurial hi-tech start-ups: a new perspective and supporting case study. *Technovation,* 25, 739-752.

Patel, P.C., & Conklin, B. (2012). Perceived labor productivity in small firms-The effects of high-performance work systems and group culture through employee retention. *Entrepreneurship Theory & Practice*, 36, 205-235.

Perry, J.T., Chandler, G.N., & Markova, G. (2012). Entrepreneurial effectuation: A review and suggestions for future research. *Entrepreneurship Theory & Practice*, 36, 837-861.

Podsakoff, P.M., & Organ, D.W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management*, 12, 531-544.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., & Podsakoff, N.P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879-903.

Politis, D.D., Winborg, J., & Lindholm Dahlstrand, A. (2011). Exploring the resource logic of student entrepreneurs. *International Small Business Journal*, 30, 659-683.

Porter, M.E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors.* New York, NY: Free Press.

Porter, M.E. (1990). *The Competitive Advantage of Nations*. Cambridge, MA: Harvard University Press.

Rasiah, R. (2017). The role of institutions and linkages in learning and innovation. *International Journal of Institutions and Economies*, 3, 165-172.

Read, S., & Sarasvathy, S.D. (2005). Knowing what to do and doing what you know: Effectuation as a form of entrepreneurial expertise. *Journal of Private Equity*, 9, 45-62.

Read, S., Sarasvathy, S.D., Dew, N., & Wiltbank, R. (2016). Response to Arend et al.: Co-creating effectual entrepreneurship research. *Academy of Management Review*, 41, 528-536.

Read, S., Sarasvathy, S.D., Dew, N., Wiltbank, R., & Ohlsson, A.-V. (2011). *Effectual entrepreneurship.* London, UK: Routledge.

Read, S., Song, M., & Smit, W. (2009). A meta-analytic review of effectuation and venture performance. *Journal of Business Venturing*, 24, 573-587.

Reay, T., & Jones, C. (2016). Qualitatively capturing institutional logics. *Strategic Organization*, 14, 441-454.

Reuber, A.R., Fischer, E., & Coviello, N. (2016). Deepening the dialogue: New directions for the evolution of effectuation theory. *Academy of Management Review*, 41, 536-540.

Reuters (2019). *Profile: Caterpillar Inc (CAT.N)*. Available at: https://www.reuters.com/finance/stocks/company-profile/CAT (accessed 19-02-2019).

Reymen, I., Andries, P., Berends, H., Mauer, R., Stephan, U., & Van Burg, E. (2015). Understanding dynamics of strategic decision-making in venture creation: A process study of effectuation and causation. *Strategic Entrepreneurship Journal*, 9, 351-379.

Robinson, P., Huefner, J., & Hunt, K. (1991). Entrepreneurial research on student subjects does not generalize to real world entrepreneurs. *Journal of Small Business Management*, 29, 42-50.

Rodríguez-Pose, A., & Di Cataldo, M. (2014). Quality of government and innovative performance in the regions of Europe. *Journal of Economic Geography*, 15, 673-706.

Ronen, S., & Shenkar, O. (1985). Clustering countries on attitudinal dimensions: A review and synthesis. *Academy of Management Review*, 10, 435-454.

Rothaermel, F.T., & Deeds, D.L. (2006). Alliance type, alliance experience and alliance management capability in high-technology ventures. *Journal of Business Venturing*, 21, 429-460.

Ruef, M., & Patterson, K. (2009). Credit and classification: The impact of industry boundaries in nineteenth-century America. *Administrative Science Quarterly*, 54, 486-520.

Ruttan, V. (2006). *Is war necessary for economic growth? Military procurement and technology development*. New York, NY: Oxford University Press.

Sambharya, R., & Musteen, M. (2014). Institutional environment and entrepreneurship: an empirical study across countries. *Journal of International Entrepreneurship*, 12, 314-330.

Sarasvathy, S.D. & Dew, N. (2005). New market creation through transformation. *Journal of Evolutionary Economics*, 15, 533-565.

Sarasvathy, S.D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*, 26, 243-263.

Sarasvathy, S.D. (2003). Entrepreneurship as a science of the artificial. *Journal of Economic Psychology*, 24, 203-220.

Sarasvathy, S.D. (2008). *Effectuation: Elements of entrepreneurial expertise.* Northampton, MA: Edward Elgar.

Sarasvathy, S.D., & Dew, N. (2008). Effectuation and over-trust: Debating Goel and Karri. *Entrepreneurship Theory & Practice*, 32, 727-737.

Sarasvathy, S.D., & Venkataraman, S. (2001). *Strategy and entrepreneurship: Outlines of an untold story*. Oxford, UK: Blackwell.

Sarasvathy, S.D., Dew, N., Read, S., & Wiltbank, R. (2008). Designing organizations that design environments: Lessons from entrepreneurial expertise. *Organization Studies*, 29, 331-350.

Saxenian, A. (1990). Regional networks and the resurgence of Silicon Valley. *California Management Review*, 33, 89-112.

Schaper, M. (2016). *Making ecopreneurs: Developing sustainable entrepreneurship*. New York, NY: Routledge.

Schneiberg, M. (2006). What's on the path? Path dependence, organizational diversity and the problem of institutional change in the US economy, 1900–1950. *Socio-Economic Review*, 5, 47-80.

Schwenk, C.R., & Shrader, C.B. (1993). Effects of formal strategic planning on financial performance in small firms: A meta-analysis. *Entrepreneurship Theory & Practice*, 17, 53-65.

Scott-Smith, G., & Smeets, M. (2013). Noblesse oblige: The transatlantic security dynamic and Dutch involvement in the Joint Strike Fighter program. *International Journal*, 68, 49-69.

Seelos, C., & Mair, J. (2005). Social entrepreneurship: Creating new business models to serve the poor. *Business Horizons*, 48, 241-246.

SESAR (2016). *European Drones Outlook Study. Unlocking the value for Europe*. Available at: http://www.sesarju.eu/sites/default/files/documents/reports/European_Drones_Outlook_Study_2016.pdf (accessed 25-10-2018).

Shepherd, D.A., Wennberg, K., Suddaby, R., & Wiklund, J. (2019). What are we explaining? A review and agenda on initiating, engaging, performing, and contextualizing Entrepreneurship. *Journal of Management*, 45, 159-196.

Sieger, P., & Monsen, E. (2015). Founder, academic, or employee? A nuanced study of career choice intentions. *Journal of Small Business Management*, 53, 30-57.

Sieger, P., Fueglistaller, U., & Zellweger, T. (2011). *Entrepreneurial intentions and activities of students across the world. International report of the GUESSS project 2011.* St.Gallen: Swiss Research Institute of Small Business and Entrepreneurship at the University of St.Gallen (KMU-HSG).

Sitoh, M.K., Pan, S.L., & Yu, C.Y. (2014). Business models and tactics in new product creation: The interplay of effectuation and causation processes. *IEEE Transactions on Engineering Management*, 61, 213-224.

Slater, S.F. & Atuahene-Gima, K. (2004). Conducting survey research in strategic management. In Ketchen, D. J. & Bergh, D. D. (Eds.), *Research methodology in strategy and management*, (pp. 227-249). Amsterdam, NL: Elsevier.

Souitaris, V., Zerbinati, S., & Al-Laham, A. (2007). Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students?

The effect of learning, inspiration and resources. *Journal of Business Venturing*, 22, 566-591.

Spencer, J.W., & Gómez, C. (2004). The relationship among national institutional structures, economic factors, and domestic entrepreneurial activity: A multicountry study. *Journal of Business Research*, 57, 1098-1107.

Staatscourant (2016). *Regeling van de Staatssecretaris van Infrastructuur en Milieu, van 30 mei 2016, nr. IENM/BSK-2016/55217, tot wijziging van de Regeling op afstand bestuurde luchtvaartuigen in verband met versoepeling van de regels voor op afstand bestuurde luchtvaartuigen van niet meer dan 4 kg die vliegen onder specifieke operationele beperkingen. No. 27757*. Available at: https://zoek.officielebekendmakingen.nl/stcrt-2016-27757.html (accessed 25-10-2018).

Stenholm, P., Acs, Z.J., & Wuebker, R. (2013). Exploring country-level institutional arrangements on the rate and type of entrepreneurial activity. *Journal of Business Venturing*, 28, 176-193.

Stephan, U., Uhlaner, L.M., & Stride, C. (2015). Institutions and social entrepreneurship: The role of institutional voids, institutional support, and institutional configurations. *Journal of International Business Studies*, 46, 308-331.

Stevens, R., Moray, N., & Bruneel, J. (2015). The social and economic mission of social enterprises: Dimensions, measurement, validation, and relation. *Entrepreneurship Theory & Practice*, 39, 1051-1082.

Storey, D.J. (2003). Entrepreneurship, small and medium sized enterprises and public policy. In: Acs, Z.J. & Audretsch, D.B. (Eds.), *International Handbook of Entrepreneurship Research* (pp. 473–513). Dordrecht, NL: Kluwer Academic.

Sullivan Mort, G., Weerawardena, J., & Liesch, P. (2012). Advancing entrepreneurial marketing: Evidence from born global firms. *European Journal of Marketing*, 46, 542-561.

Te Kulve, H., & Smit, W.A. (2003). Civilian–military co-operation strategies in developing new technologies. *Research Policy*, 32, 955-970.

Teece, D.J. (1998). Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets. *California Management Review*, 40, 55-79.

Teng, B.S. (2007). Corporate entrepreneurship activities through strategic alliances: A resource-based approach toward competitive advantage. *Journal of Management Studies*, 44, 119-142.

The Economist (2015). *Up*. Available at: http://www.economist.com/news/business/21647981-chinese-firm-has-taken-lead-promising-market-up (accessed 25-10-2018).

Thompson, R.E., Voit, E.O., & Scott, G.I. (2000). Statistical modeling of sediment and oyster PAH contamination data collected at a South Carolina estuary (complete and left-censored samples). *Environmetrics*, 11, 99-119.

Trimi, S., & Berbegal-Mirabent, J. (2012). Business model innovation in entrepreneurship. *International Entrepreneurship and Management Journal*, 8, 449-465.

Tripsas, M. (1997). Unraveling the process of creative destruction: Complementary assets and incumbent survival in the typesetter industry. *Strategic Management Journal*, 18, 119-142.

Tryba, A., & Fletcher, D. (2019). How shared pre-start-up moments of transition and cognitions contextualize effectual and causal decisions in entrepreneurial teams. *Small Business Economics*, 1-24.

U.S. Department of Transportation (2013). *Unmanned Aircraft System (UAS) Service Demand 2015-2035: Literature Review and Projections of Future Usage*. Res. Washington, DC. Tech. Rep. DOT-VNTSC-DoD-13-01.

Ucbasaran, D., Westhead, P., & Wright, M. (2001). The focus of entrepreneurial research: Contextual and process issues. *Entrepreneurship Theory & Practice*, 25, 57-80.

Uhlaner, L., & Thurik, R. (2007). Postmaterialism influencing total entrepreneurial activity across nations. *Journal of Evolutionary Economics*, 17, 161-185.

Urbano, D., & Alvarez, C. (2014). Institutional dimensions and entrepreneurial activity: An international study. *Small Business Economics*, 42, 703-716.

Van Buuren, S., & Groothuis-Oudshoorn, K. (2010). Mice: Multivariate imputation by chained equations in R. *Journal of Statistical Software*, 1-68.

Van de Vijver, M., & Vos, B. (2006). The F-35 Joint Strike Fighter as a source of innovation and employment: some interim results. *Defence and Peace Economics*, 17, 155-159.

Van de Vijver, M., & Vos, B. (2007). Improving competitive positioning in the aerospace industry: A case study of Dutch participation in the F-35 Lightening II (JSF) programme. *Defence and Peace Economics*, 18, 509-517.

Van Praag, C.M. (2003). Business survival and success of young small business owners. *Small Business Economics*, 21, 1-17.

Van Stel, A., Carree, M., & Thurik, R. (2005). The effect of entrepreneurial activity on national economic growth. *Small Business Economics*, 24, 311-321.

Venkatraman, N.U., & Ramanujam, V. (1987). Measurement of business economic performance: An examination of method convergence. *Journal of Management*, 13, 109-122.

Verbeke, A. (2018). *Panel Discussion, The 'New Normal'*. Presentation, Lyon (France).

Vucetic, S., & Nossal, K.R. (2013). The international politics of the F-35 Joint Strike Fighter. *International Journal*, 68, 3-12.

Watson, T.J. (2013). Entrepreneurship in action: Bringing together the individual, organizational and institutional dimensions of entrepreneurial action. *Entrepreneurship & Regional Development*, 25, 404-422.

Webb, J.W., Kistruck, G.M., Ireland, R.D., & Ketchen Jr, D.J. (2010). The entrepreneurship process in base of the pyramid markets: The case of multinational enterprise/nongovernment organization alliances. *Entrepreneurship Theory & Practice*, 34, 555-581.

Welter, C., Mauer, R., & Wuebker, R.J. (2016). Bridging behavioral models and theoretical concepts: Effectuation and bricolage in the opportunity creation framework. *Strategic Entrepreneurship Journal*, 10, 5-20.

Wennekers, S., Van Stel, A., Thurik, R., & Reynolds, P. (2005). Nascent entrepreneurship and the level of economic development. *Small Business Economics*, 24, 293-309.

Werhahn, D., Mauer, R., Flatten, T.C., & Brettel, M. (2015). Validating effectual orientation as strategic direction in the corporate context. *European Management Journal*, 33, 305-313.

Wiklund, J., & Shepherd, D.A. (2003). Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized businesses. *Strategic Management Journal*, 24, 1307-1314.

Wiltbank, R., Dew, N., Read, S., & Sarasvathy, S.D. (2006). What to do next? The case for non-predictive strategy. *Strategic Management Journal*, 27, 981-998.

Wiltbank, R., Read, S., Dew, N., & Sarasvathy, S.D. (2009). Prediction and control under uncertainty: Outcomes in angel investing. *Journal of Business Venturing*, 24, 116-133.

WinterGreen Research (2015). *Commercial Drones: Highways in the Sky, Unmanned Aerial Systems (UAS), Market Shares, Strategies, and Forecasts, Worldwide, 2015 to 2021*. Available at: http://www.wintergreenresearch.com/index.php?route=product/product&product_id=2060 (accessed 25-10-2018).

Wong, P.K., Ho, Y.P., & Autio, E. (2005). Entrepreneurship, innovation and economic growth: Evidence from GEM data. *Small Business Economics*, 24, 335-350.

Woolf, S.H. (2008). The meaning of translational research and why it matters. *Jama*, 299, 211-213.

Worren, N., Moore, K., & Cardona, P. (2002). Modularity, strategic flexibility, and firm performance: A study of the home appliance industry. *Strategic Management Journal*, 23, 1123-1140.

Yildirim, J., & Öcal, N. (2016). Military expenditures, economic growth and spatial spillovers. *Defence and Peace Economics*, 27, 87-104.

Zahra, S.A., Rawhouser, H.N., Bhawe, N., Neubaum, D.O., & Hayton, J.C. (2008). Globalization of social entrepreneurship opportunities. *Strategic Entrepreneurship Journal*, 2, 117-131.

Zahra, S.A., Wright, M., & Abdelgawad, S.G. (2014). Contextualization and the advancement of entrepreneurship research. *International Small Business Journal*, 32, 479-500.

Zeitz, G. (1980). Interorganizational dialectics. *Administrative Science Quarterly*, 25, 72-88.

Zellweger, T., Richards, M., Sieger, P., & Patel, P.C. (2016). How much am I expected to pay for my parents' firm? An institutional logics perspective on family discounts. *Entrepreneurship Theory & Practice*, 40, 1041-1069.

Zhao, H., Seibert, S.E., & Hills, G.E. (2005). The mediating role of self-efficacy in the development of entrepreneurial intentions. *Journal of Applied Psychology*, 90, 1265-1272.

Zheng, Y., & Mai, Y. (2013). A contextualized transactive memory system view on how founding teams respond to surprises: Evidence from China. *Strategic Entrepreneurship Journal*, 7, 197-213.

Zietsma, C., & McKnight, B. (2009). Building the iron cage: institutional creation work in the context of competing proto-institutions. In: Lawrence, T.B., Suddaby, R., & Leca, B. (Eds.), *Institutional Work: Actors and Agency in Institutional Studies of Organizations* (pp. 143-177). Cambridge, UK: Cambridge University Press.

Summary

Entrepreneurship fosters innovation. It is a key driver of economic development, growth and job creation, while also creating opportunities for new products, services, business models, as well as for new markets to be developed. Entrepreneurship is essential not only to leading economies, but also a driver for positive change in the world. In order to capture the multifaceted face of entrepreneurship, the three studies in this dissertation answer three research questions, which are aimed at studying entrepreneurship and innovation at different levels.

To start with, I focus on the micro level and consider how entrepreneurs' decision-making logics impact venture performance. I find that ventures benefit most when an entrepreneur is using two entrepreneurial logics – planning-focused causation and action-oriented effectuation – in tandem. Next, I focus on the meso level and examine how regulatory proto-institutions arise in technological innovation-intensive and behavioral change-prone organizational fields. I find that regulatory proto-institutions in nascent industries tend to result from dialectic institutional work in the form of structured interactions between entrepreneurs and regulators. New regulatory structures evolve in contexts where high levels of technological and behavioral change induce systemic uncertainty and enlarge the interdependence between entrepreneurs and regulators. Lastly, I focus on the macro level and investigate how the military supports civil innovation institutions to develop market-ready products. I find that the military, as a previously overlooked institution, plays an integral role in civil innovation around the globe. Although some public and private institutions help bring innovation to the market, the military is an even stronger driver for a country's innovative strength in the civil sector.

By thoroughly investigating entrepreneurship and innovation at different level of analysis, including the use of different concepts and distinct methods, I am able to arrive at relevant conclusions that have an impact on individual entrepreneurs (micro), entrepreneur-stakeholder interactions (meso), as well as national innovation systems (macro). Whether in this dissertation or in future research, existing opportunities reside across levels of analysis, through which numerous approaches, concepts, and methods of entrepreneurship and innovation get to interact.

Samenvatting (Summary in Dutch)

Ondernemerschap stimuleert innovatie. Het is een belangrijke motor voor economische ontwikkeling, groei en het creëren van banen, en schept tegelijkertijd ook kansen voor nieuwe producten, diensten, bedrijfsmodellen en zelfs voor de ontwikkeling van nieuwe markten. Ondernemerschap is niet alleen essentieel voor toonaangevende economieën, maar ook een kracht voor positieve verandering in de wereld. Om het veelzijdige gezicht van ondernemerschap te vatten, beantwoorden de drie studies in dit proefschrift drie onderzoeksvragen, die gericht zijn op het bestuderen van ondernemerschap en innovatie op verschillende niveaus.

Ik begin met het microniveau en overweeg hoe de besluitvormingslogica van ondernemers de prestaties van een onderneming beïnvloedt. De resultaten laten zien dat ondernemingen er het meest bij gebaat zijn wanneer een ondernemer twee ondernemerslogica – planningsgeoriënteerde 'causation' en actiegerichte 'effectuation' – in gezamenlijkheid gebruikt. Vervolgens kijk ik naar het mesoniveau en onderzoek ik hoe regulatieve proto-instituties ontstaan in technologische innovatie-intensieve en gedragsgevoelige organisatorische velden. Regulatieve proto-instituties in nieuwe industrieën komen voort uit dialectisch institutioneel werk, wat bestaat uit gestructureerde interacties tussen ondernemers en regelgevers. Nieuwe regulatieve structuren evolueren in contexten waarin hoge niveaus van technologische en gedragsverandering systemische onzekerheid teweegbrengen en de onderlinge afhankelijkheid tussen ondernemers en regelgevers vergroten. Ten slotte beschouw ik het macroniveau en onderzoek ik hoe het militair-industriële complex civiele innovatie-instellingen ondersteunt om marktklare producten te ontwikkelen. Het militair-industriële complex, een voorheen over het hoofd geziene institutie, speelt een integrale rol in civiele innovatie over de hele wereld. Hoewel sommige publieke en private instituties bijdragen aan marktinnovatie, blijkt het militair-industriële complex een nog sterkere factor te zijn die de innovatiekracht van een land in de civiele sector helpt ontwikkelen.

Door grondig onderzoek naar ondernemerschap en innovatie op verschillende niveaus van analyse te doen, inclusief het gebruik van afzonderlijke maar complementaire concepten en methoden, ben ik in staat om tot relevante conclusies te komen die een impact hebben op individuele ondernemers (micro), interacties tussen ondernemers en belanghebbenden (meso), en nationale innovatiesystemen (macro). Kansen voor vervolgonderzoek liggen op verschillende niveaus van analyse, waardoor een veelheid aan benaderingen, concepten en methoden van ondernemerschap en innovatie met elkaar in wisselwerking kunnen treden.

Zusammenfassung (Summary in German)

Unternehmerschaft und Gründergeist fördern Innovation. Sie sind ein wesentlicher Antrieb für wirtschaftliches Wachstum und Entwicklung, die Schaffung von Arbeitsplätzen und bieten gleichzeitig Möglichkeiten zur Entstehung neuer Produkte, Dienstleistungen und Geschäftsmodelle, sowie für die Erschließung neuer Märkte. Unternehmertum ist nicht nur für führende Volkswirtschaften von entscheidender Bedeutung, sondern auch ein Motor für positive Veränderungen in der Welt. Um die vielen Facetten des Unternehmertums zu erforschen, beantworten die drei Studien meiner Dissertation drei Forschungsfragen, die darauf abzielen, Unternehmertum und Innovation auf verschiedenen Ebenen zu untersuchen.

Zunächst beginne ich mit der Mikroebene und erfrage, wie sich die Entscheidungslogik von Gründern auf ihren Unternehmenserfolg auswirkt. Die Ergebnisse zeigen, dass Firmen am meisten davon profitieren, wenn ein Gründer zwei unternehmerische Logiken - planungsorientiertes „Causation“ und handlungsorientiertes „Effectuation“ - gleichzeitig benutzt. Als nächstes lege ich den Fokus auf die Mesoebene und untersuche, wie regulierende Protoinstitutionen in technologischen, innovationsintensiven und für Verhaltensänderungen anfälligen Organisationsfeldern entstehen. Regulierende Protoinstitutionen in sich neu entwickelnden Industrien wachsen aus dialektischer institutioneller Arbeit, welche aus strukturierten Interaktionen zwischen Unternehmern und Gesetzesgebern besteht. Neue Regulierungsstrukturen entstehen in Kontexten, in denen ein hohes Maß an technologischen und verhaltensbedingten Veränderungen systemische Unsicherheiten hervorrufen und die gegenseitige Abhängigkeit zwischen Unternehmern und gesetzgebenden Instanzen vergrößern. Zuletzt beschäftige ich mich mit der Makroebene und untersuche, wie das Militär zivile Innovationsinstitutionen in der Entwicklung marktreifer Produkte unterstützt. Das Militär, eine zuvor oft übersehene Institution, spielt eine wichtige Rolle für zivile Innovationen weltweit. Obwohl einige öffentliche und private Institutionen dazu beitragen, Innovationen auf den Markt zu bringen, ist das Militär eine noch stärkere Triebkraft für die Innovationsfähigkeit eines Landes im zivilen Sektor.

Durch das Erforschen von Unternehmertum und Innovation auf verschiedenen Analyseebenen, einschließlich der Verwendung diverser Konzepte und unterschiedlicher Methoden, kann ich relevante Schlussfolgerungen ziehen, die Einfluss haben auf Gründer (Mikro), die Interaktion zwischen Unternehmern und Gesetzgebern (Meso), sowie nationale Innovationssysteme (Makro). Möglichkeiten für zukünftige Forschung bieten sich auf verschiedenen Analyseebenen, auf denen eine Vielzahl von gründungsrelevanten und innovationsbezogenen Ansätzen, Konzepten und Methoden kombiniert eingesetzt werden können.

About the Author

Katrin M. Smolka was born in Hamburg, Germany. She holds a Bachelor's degree in Tourism Management (cum laude) from NHTV Breda (now: Breda University of Applied Sciences), the Netherlands, and a Master's degree in Entrepreneurship and New Business Venturing from Rotterdam School of Management (RSM), Erasmus University, the Netherlands. After graduation, she joined the Department of Strategic Management and Entrepreneurship at RSM as lecturer and researcher. During that time, Katrin started working on her PhD dissertation to investigate ways in which entrepreneurs deal with uncertainty, how institutions emerge and what stimulates innovation, especially in environments driven by technological change. In doing so, she mainly focused on a new and emerging industry, namely the industry for remotely piloted aircraft systems (commonly known as drones). Katrin also spent three months on a research visit at Kühne Logistics University, Germany.

Katrin's research interests cover entrepreneurial decision-making under uncertainty, cognition and start-up behavior as well as industry emergence, institutional work and innovation more broadly. Her research output was presented at several scientific conferences in the field, for example at the Babson College Entrepreneurship Research Conference (BCERC), the Academy of Management (AOM) Annual Meeting or the Organization Science Winter Conference. Katrin was also invited to present her research at industry conferences. The first study of her dissertation is published in *Entrepreneurship Theory & Practice*, one of the leading journals in the field of entrepreneurship.

In her work as lecturer, Katrin was given the opportunity to gain valuable experiences in the classroom, through managing, coordinating and teaching large-scale courses. She taught in both the Dutch and the international BSc Business Administration program. In particular, she was responsible for the course Strategic Business Plan where more than 1,200 students annually developed a business strategy for a real-life small or medium sized company. Next to classes in strategic management, Katrin contributed to a variety of entrepreneurship courses. Additionally, she supervised several master theses and bachelor internships.

Besides research and teaching, Katrin was actively engaged in committee work aimed at monitoring and improving the quality of RSM's Bachelor programs. She annually organized and hosted the Strategic Business Plan Awards, a business plan competition for first-year students at RSM, and was part of the local organizing team of the European Group for Organizational Studies' (EGOS) flagship conference in 2014.

Katrin currently works as Assistant Professor in the Entrepreneurship and Innovation Group at Warwick Business School, University of Warwick (UK).

Portfolio

PUBLICATIONS (PEER REVIEWED)

Journal Article

Smolka, K.M., Verheul, I., Burmeister-Lamp, K. & Heugens, P.P.M.A.R. (2018) Get it together! Synergistic Effects of Causal and Effectual Decision-Making Logics on Venture Performance. *Entrepreneurship Theory & Practice*, Vol. 42(4), 571-604.

Book Chapter

Park, S., Martina, M.A. & Smolka, K.M. (forthcoming) Working Passionately Does Not Always Pay Off: The Negative Moderating Role of Passion on the Relationship Between Deliberate Practice and Venture Performance. In: Caputo, A. and Pellegrini, M. M. *The Anatomy of Entrepreneurial Decisions and Negotiations*. Springer Publishing.

NON-DISSERTATION WORKING PAPERS

The Effectiveness of Entrepreneurship Education (with T.H.J. Geradts & A. Rauch).

Decision-Making in Teams: Idea Innovativeness and the Use of Predictive vs. Non-Predictive Logics (with T.H.J. Geradts).

Insights into Entrepreneurial Narratives from the DotCom Era and Blockchain (with A. Windawi).

CONFERENCE PRESENTATIONS

2019:

- Babson College Entrepreneurship Research Conference, Babson Park (US)
- Industry Studies Conference, Nashville (US)

2018:

- Technology, Innovation und Entrepreneurship Conference 2018, Hamburg (GER)
- EURAM 2018, Reykjavik (IS)
- 2018 Effectuation Conference, Charlottesville (US)
- Organization Science Winter Conference, Park City (US)

2017:

- Academy of Management Annual Meeting, Atlanta (US)
- Entrepreneurship Research: Past, Present & Future, Paris (FR)
- Leuphana Conference on Entrepreneurship, Lüneburg (GER)

2016:

- Airneth Unmanned Aircraft Systems Seminar of the Netherlands Institute for Transport Policy Analysis, The Hague (NL)
- 10th Research Seminar of the Dutch Academy of Research in Entrepreneurship, Amsterdam (NL)
- G-Forum, 20th Annual Interdisciplinary Entrepreneurship Conference, Leipzig (GER)
- 4th Effectuation Research and Teaching Conference, Bodø (NO)
- Unmanned Cargo Aircraft Conference, Enschede (NL)

2015:

- Academy of Management Annual Meeting, Vancouver (CA)

2014:

- 3rd Effectuation Research and Teaching Conference, Enschede (NL)
- G-Forum, 18th Annual Interdisciplinary Entrepreneurship Conference, Oldenburg (GER)
- Babson College Entrepreneurship Research Conference, London (CA)

2013:

- Babson College Entrepreneurship Research Conference, Lyon (FR)
- 2nd Effectuation Research and Teaching Conference, Lyon (FR)

DOCTORAL CONSORTIA, STIPENDS, GRANTS AND AWARDS

2019:

- Global Faculty Development Program at Wharton, University of Pennsylvania, three-day workshop, fully funded

2018:

- Academy of Management Annual Meeting, Doctoral Consortium of the OMT Division

2017:

- Academy of Management Annual Meeting, Doctoral Consortium of the TIM Division
- IX Medici Summer School themed "The Organization of Innovation and Entrepreneurship" at MIT, Sloan School of Management, one-week programme, fully funded
- Travel endowment of the Erasmus Trustfonds for attending the 2017 Academy of Management Annual Meeting, awarded with a €500 grant

- Best Paper Award by the International Small Business Journal (3rd place) of the Entrepreneurship Research: Past, Present & Future conference at Paris School of Business
- Entrepreneurship Research: Past, Present & Future at Paris School of Business, Doctoral Consortium (group of William Gartner)
- Leuphana Conference on Entrepreneurship, Doctoral Writing Workshop (group of Per Davidsson)

2016:

- G-Forum, 20th Annual Interdisciplinary Entrepreneurship Conference, Doctoral Consortium
- Babson College Entrepreneurship Research Conference, Doctoral Consortium (20% acceptance rate), awarded with $1125 stipend

2015:

- Academy of Management Annual Meeting, Doctoral Consortium of the Entrepreneurship Division, awarded with $750 stipend
- Travel endowment of the Erasmus Trustfonds for attending the 2015 Academy of Management Annual Meeting, awarded with a €500 grant

ERIM PhD Series

The ERIM PhD Series contains PhD dissertations in the field of Research in Management defended at Erasmus University Rotterdam and supervised by senior researchers affiliated to the Erasmus Research Institute of Management (ERIM). All dissertations in the ERIM PhD Series are available in full text through the ERIM Electronic Series Portal: http://repub.eur.nl/pub. ERIM is the joint research institute of the Rotterdam School of Management (RSM) and the Erasmus School of Economics (ESE) at the Erasmus University Rotterdam (EUR).

Dissertations in the last four years

Ahmadi, S., *A motivational perspective to decision-making and behavior in organizations*, Promotors: Prof. J.J.P. Jansen & Dr T.J.M. Mom, EPS-2019-477-S&E, https://repub.eur.nl/pub/116727

Akemu, O., *Corporate Responses to Social Issues: Essays in Social Entrepreneurship and Corporate Social Responsibility*, Promotors: Prof. G.M. Whiteman & Dr S.P. Kennedy, EPS-2017-392-ORG, https://repub.eur.nl/pub/95768

Albuquerque de Sousa, J.A., *International stock markets: Essays on the determinants and consequences of financial market development*, Promotors: Prof. M.A. van Dijk & Prof. P.A.G. van Bergeijk, EPS-2019-465-F&A, https://repub.eur.nl/pub/115988

Alexiou, A. *Management of Emerging Technologies and the Learning Organization: Lessons from the Cloud and Serious Games Technology*, Promotors: Prof. S.J. Magala, Prof. M.C. Schippers and Dr I. Oshri, EPS-2016-404-ORG, http://repub.eur.nl/pub/93818

Alserda, G.A.G., *Choices in Pension Management*, Promotors: Prof. S.G. van der Lecq & Dr O.W. Steenbeek, EPS-2017-432-F&A, https://repub.eur.nl/pub/103496

Arampatzi, E., *Subjective Well-Being in Times of Crises: Evidence on the Wider Impact of Economic Crises and Turmoil on Subjective Well-Being*, Promotors: Prof. H.R. Commandeur, Prof. F. van Oort & Dr. M.J. Burger, EPS-2018-459-S&E, https://repub.eur.nl/pub/111830

Avci, E., *Surveillance of Complex Auction Markets: a Market Policy Analytics Approach*, Promotors: Prof. W. Ketter, Prof. H.W.G.M. van Heck & Prof. D.W. Bunn, EPS-2018-426-LIS, https://repub.eur.nl/pub/106286

Balen, T.H. van, *Challenges of Early Stage Entrepreneurs: the Roles of Vision Communication and Team Membership Change*, Promotors: Prof. J.C.M. van den Ende & Dr M. Tarakci, EPS-2019-468-LIS, https://repub.eur.nl/pub/115654

Bernoster, I., *Essays at the Intersection of Psychology, Biology, and Entrepreneurship,* Promotors: Prof. A.R. Thurik, Prof. I.H.A. Franken & Prof. P.J.F Groenen, EPS-2018-463-S&E, https://repub.eur.nl/pub/113907

Beusichem, H.C. van, *Firms and Financial Markets: Empirical Studies on the Informational Value of Dividends, Governance and Financial Reporting*, Promotors: Prof. A. de Jong & Dr G. Westerhuis, EPS-2016-378-F&A, http://repub.eur.nl/pub/93079

Bouman, P., *Passengers, Crowding and Complexity: Models for Passenger Oriented Public Transport*, Prof. L.G. Kroon, Prof. A. Schöbel & Prof. P.H.M. Vervest, EPS-2017-420-LIS, https://repub.eur.nl/100767

Brazys, J., *Aggregated Marcoeconomic News and Price Discovery*, Promotor: Prof. W.F.C. Verschoor, EPS-2015-351-F&A, http://repub.eur.nl/pub/78243

Bunderen, L. van, *Tug-of-War: Why and when teams get embroiled in power struggles*, Promotors: Prof. D.L. van Knippenberg & Dr. L. Greer, EPS-2018-446-ORG, https://repub.eur.nl/pub/105346

Burg, G.J.J. van den, *Algorithms for Multiclass Classification and Regularized Regression*, Promotors: Prof. P.J.F. Groenen & Dr. A. Alfons, EPS-2018-442-MKT, https://repub.eur.nl/pub/103929

Chammas, G., *Portfolio concentration*, Promotor: Prof. J. Spronk, EPS-2017-410-F&E, https://repub.eur.nl/pub/94975

Cranenburgh, K.C. van, *Money or Ethics: Multinational corporations and religious organisations operating in an era of corporate responsibility*, Prof. L.C.P.M. Meijs, Prof. R.J.M. van Tulder & Dr D. Arenas, EPS-2016-385-ORG, http://repub.eur.nl/pub/93104

Consiglio, I., *Others: Essays on Interpersonal and Consumer Behavior*, Promotor: Prof. S.M.J. van Osselaer, EPS-2016-366-MKT, http://repub.eur.nl/pub/79820

Darnihamedani, P. *Individual Characteristics, Contextual Factors and Entrepreneurial Behavior*, Promotors: Prof. A.R. Thurik & S.J.A. Hessels, EPS-2016-360-S&E, http://repub.eur.nl/pub/93280

Dennerlein, T. *Empowering Leadership and Employees' Achievement Motivations: the Role of Self-Efficacy and Goal Orientations in the Empowering Leadership Process*, Promotors: Prof. D.L. van Knippenberg & Dr J. Dietz, EPS-2017-414-ORG, https://repub.eur.nl/pub/98438

Depecik, B.E., *Revitalizing brands and brand: Essays on Brand and Brand Portfolio Management Strategies*, Promotors: Prof. G.H. van Bruggen, Dr Y.M. van Everdingen and Dr M.B. Ataman, EPS-2016-406-MKT, http://repub.eur.nl/pub/93507

Duijzer, L.E., *Mathematical Optimization in Vaccine Allocation*, Promotors: Prof. R. Dekker & Dr W.L. van Jaarsveld, EPS-2017-430-LIS, https://repub.eur.nl/pub/101487

El Nayal, O.S.A.N., *Firms and the State: An Examination of Corporate Political Activity and the Business-Government Interface*, Promotor: Prof. J. van Oosterhout & Dr. M. van Essen, EPS-2018-469-S&E, https://repub.eur.nl/pub/114683

Erlemann, C., *Gender and Leadership Aspiration: The Impact of the Organizational Environment*, Promotor: Prof. D.L. van Knippenberg, EPS-2016-376-ORG, http://repub.eur.nl/pub/79409

Feng, Y., *The Effectiveness of Corporate Governance Mechanisms and Leadership Structure: Impacts on strategic change and firm performance*, Promotors: Prof. F.A.J. van den Bosch, Prof. H.W. Volberda & Dr J.S. Sidhu, EPS-2017-389-S&E, https://repub.eur.nl/pub/98470

Fisch, C.O., *Patents and trademarks: Motivations, antecedents, and value in industrialized and emerging markets*, Promotors: Prof. J.H. Block, Prof. H.P.G. Pennings & Prof. A.R. Thurik, EPS-2016-397-S&E, http://repub.eur.nl/pub/94036

Fliers, P.T., *Essays on Financing and Performance: The role of firms, banks and board*, Promotors: Prof. A. de Jong & Prof. P.G.J. Roosenboom, EPS-2016-388-F&A, http://repub.eur.nl/pub/93019

Frick, T.W., *The Implications of Advertising Personalization for Firms, Consumer, and Ad Platfroms*, Promotors: Prof. T. Li & Prof. H.W.G.M. van Heck, EPS-2018-452-LIS, https://repub.eur.nl/pub/110314

Fytraki, A.T., *Behavioral Effects in Consumer Evaluations of Recommendation Systems*, Promotors: Prof. B.G.C. Dellaert & Prof. T. Li, EPS-2018-427-MKT, https://repub.eur.nl/pub/110457

Gaast, J.P. van der, *Stochastic Models for Order Picking Systems*, Promotors: Prof. M.B.M de Koster & Prof. I.J.B.F. Adan, EPS-2016-398-LIS, http://repub.eur.nl/pub/93222

Ghazizadeh, P. *Empirical Studies on the Role of Financial Information in Asset and Capital Markets*, Promotors: Prof. A. de Jong & Prof. E. Peek. EPS-2019-470-F&A https://repub.eur.nl/pub/114023

Giurge, L., *A Test of Time; A temporal and dynamic approach to power and ethics*, Promotors: Prof. M.H. van Dijke & Prof. D. De Cremer, EPS-2017-412-ORG, https://repub.eur.nl/98451

Gobena, L., *Towards Integrating Antecedents of Voluntary Tax Compliance*, Promotors: Prof. M.H. van Dijke & Dr P. Verboon, EPS-2017-436-ORG, https://repub.eur.nl/pub/103276

Groot, W.A., *Assessing Asset Pricing Anomalies*, Promotors: Prof. M.J.C.M. Verbeek & Prof. J.H. van Binsbergen, EPS-2017-437-F&A, https://repub.eur.nl/pub/103490

Hanselaar, R.M., *Raising Capital: On pricing, liquidity and incentives*, Promotors: Prof. M.A. van Dijk & Prof. P.G.J. Roosenboom, EPS-2018-429-F&A-9789058925404, https://repub.eur.nl/pub/113274

Harms, J. A., *Essays on the Behavioral Economics of Social Preferences and Bounded Rationality*, Prof. H.R. Commandeur & Dr K.E.H. Maas, EPS-2018-457-S&E, https://repub.eur.nl/pub/108831

Hendriks, G., *Multinational Enterprises and Limits to International Growth: Links between Domestic and Foreign Activities in a Firm's Portfolio,* Promotors: Prof. P.P.M.A.R. Heugens & Dr A.H.L Slangen, EPS-2019-464-S&E, https://repub.eur.nl/pub/114981

Hengelaar, G.A., *The Proactive Incumbent: Holy grail or hidden gem? Investigating whether the Dutch electricity sector can overcome the incumbent's curse and lead the sustainability transition*, Promotors: Prof. R.J. M. van Tulder & Dr K. Dittrich, EPS-2018-438-ORG, https://repub.eur.nl/pub/102953

Jacobs, B.J.D., *Marketing Analytics for High-Dimensional Assortments*, Promotors: Prof. A.C.D. Donkers & Prof. D. Fok, EPS-2017-445-MKT, https://repub.eur.nl/pub/103497

Jia, F., *The Value of Happiness in Entrepreneurship*, Promotors: Prof. D.L. van Knippenberg & Dr Y. Zhang, EPS-2019-479-ORG, https://repub.eur.nl/pub/115990

Kahlen, M. T., *Virtual Power Plants of Electric Vehicles in Sustainable Smart Electricity Markets*, Promotors: Prof. W. Ketter & Prof. A. Gupta, EPS-2017-431-LIS, https://repub.eur.nl/pub/100844

Kampen, S. van, *The Cross-sectional and Time-series Dynamics of Corporate Finance: Empirical evidence from financially constrained firms*, Promotors: Prof. L. Norden & Prof. P.G.J. Roosenboom, EPS-2018-440-F&A, https://repub.eur.nl/pub/105245

Karali, E., *Investigating Routines and Dynamic Capabilities for Change and Innovation*, Promotors: Prof. H.W. Volberda, Prof. H.R. Commandeur and Dr J.S. Sidhu, EPS-2018-454-S&E, https://repub.eur.nl/pub/106274

Keko. E, *Essays on Innovation Generation in Incumbent Firms*, Promotors: Prof. S. Stremersch & Dr N.M.A. Camacho, EPS-2017-419-MKT, https://repub.eur.nl/pub/100841

Kerkkamp, R.B.O., *Optimisation Models for Supply Chain Coordination under Information Asymmetry*, Promotors: Prof. A.P.M. Wagelmans & Dr. W. van den Heuvel, EPS-2018-462-LIS, https://repub.eur.nl/pub/109770

Khattab, J., *Make Minorities Great Again: a contribution to workplace equity by identifying and addressing constraints and privileges*, Promotors: Prof. D.L. van Knippenberg & Dr A. Nederveen Pieterse, EPS-2017-421-ORG, https://repub.eur.nl/pub/99311

Kim, T. Y., *Data-driven Warehouse Management in Global Supply Chains*, Promotors: Prof. R. Dekker & Dr C. Heij, EPS-2018-449-LIS, https://repub.eur.nl/pub/109103

Klitsie, E.J., *Strategic Renewal in Institutional Contexts: The paradox of embedded agency*, Promotors: Prof. H.W. Volberda & Dr. S. Ansari, EPS-2018-444-S&E, https://repub.eur.nl/pub/106275

Koolen, D., *Market Risks and Strategies in Power Systems Integrating Renewable Energy*, Promotors: Prof. W. Ketter & Prof. R. Huisman, EPS-2019-467-LIS, https://repub.eur.nl/pub/115655

Kong, L. *Essays on Financial Coordination*, Promotors: Prof. M.J.C.M. Verbeek, Dr D.G.J. Bongaerts & Dr M.A. van Achter. EPS-2019-433-F&A, https://repub.eur.nl/pub/114516

Krämer, R., *A license to mine? Community organizing against multinational corporations*, Promotors: Prof. R.J.M. van Tulder & Prof. G.M. Whiteman, EPS-2016-383-ORG, http://repub.eur.nl/pub/94072

Kyosev, G.S., *Essays on Factor Investing*, Promotors: Prof. M.J.C.M. Verbeek & Dr J.J. Huij, EPS-2019-474-F&A, https://repub.eur.nl/pub/116463

Lamballais Tessensohn, T., *Optimizing the Performance of Robotic Mobile Fulfillment Systems*, Promotors: Prof. M.B.M de Koster, Prof. R. Dekker & Dr D. Roy, EPS-2019-411-LIS, https://repub.eur.nl/pub/116477

Lee, C.I.S.G., *Big Data in Management Research: Exploring New Avenues*, Promotors: Prof. S.J. Magala & Dr W.A. Felps, EPS-2016-365-ORG, http://repub.eur.nl/pub/79818

Li, X. *Dynamic Decision Making under Supply Chain Competition*, Promotors: Prof. M.B.M de Koster, Prof. R. Dekker & Prof. R. Zuidwijk. EPS-2018-466-LIS, https://repub.eur.nl/pub/114028

Liu, N., *Behavioral Biases in Interpersonal Contexts*, Supervisors: Prof. A. Baillon & Prof. H. Bleichrodt, EPS-2017-408-MKT, https://repub.eur.nl/pub/95487

Ma, Y., *The Use of Advanced Transportation Monitoring Data for Official Statistics*, Promotors: Prof. L.G. Kroon & Dr J. van Dalen, EPS-2016-391-LIS, http://repub.eur.nl/pub/80174

Maas, A.J.J., *Organizations and their external context: Impressions across time and space*, Promotors: Prof. P.P.M.A.R Heugens & Prof. T.H. Reus, EPS-2019-478-S&E, https://repub.eur.nl/pub/116480

Maira, E., *Consumers and Producers*, Promotors: Prof. S. Puntoni & Prof. C. Fuchs, EPS-2018-439-MKT, https://repub.eur.nl/pub/104387

Meulen, van der, D., *The Distance Dilemma: the effect of flexible working practices on performance in the digital workplace*, Promotors: Prof. H.W.G.M. van Heck & Prof. P.J. van Baalen, EPS-2016-403-LIS, http://repub.eur.nl/pub/94033

Moniz, A., *Textual Analysis of Intangible Information*, Promotors: Prof. C.B.M. van Riel, Prof. F.M.G de Jong & Dr G.A.J.M. Berens, EPS-2016-393-ORG, http://repub.eur.nl/pub/93001

Mulder, J., *Network design and robust scheduling in liner shipping*, Promotors: Prof. R. Dekker & Dr W.L. van Jaarsveld, EPS-2016-384-LIS, http://repub.eur.nl/pub/80258

Neerijnen, P., *The Adaptive Organization: the socio-cognitive antecedents of ambidexterity and individual exploration*, Promotors: Prof. J.J.P. Jansen, P.P.M.A.R. Heugens & Dr T.J.M. Mom, EPS-2016-358-S&E, http://repub.eur.nl/pub/93274

Okbay, A., *Essays on Genetics and the Social Sciences*, Promotors: Prof. A.R. Thurik, Prof. Ph.D. Koellinger & Prof. P.J.F. Groenen, EPS-2017-413-S&E, https://repub.eur.nl/pub/95489

Oord, J.A. van, *Essays on Momentum Strategies in Finance*, Promotor: Prof. H.K. van Dijk, EPS-2016-380-F&A, http://repub.eur.nl/pub/80036

Peng, X., *Innovation, Member Sorting, and Evaluation of Agricultural Cooperatives*, Promotor: Prof. G.W.J. Hendriks, EPS-2017-409-ORG, https://repub.eur.nl/pub/94976

Pennings, C.L.P., *Advancements in Demand Forecasting: Methods and Behavior*, Promotors: Prof. L.G. Kroon, Prof. H.W.G.M. van Heck & Dr J. van Dalen, EPS-2016-400-LIS, http://repub.eur.nl/pub/94039

Petruchenya, A., *Essays on Cooperatives: Emergence, Retained Earnings, and Market Shares*, Promotors: Prof. G.W.J. Hendriks & Dr Y. Zhang, EPS-2018-447-ORG, https://repub.eur.nl/pub/105243

Plessis, C. du, *Influencers: The Role of Social Influence in Marketing*, Promotors: Prof. S. Puntoni & Prof. S.T.L.R. Sweldens, EPS-2017-425-MKT, https://repub.eur.nl/pub/103265

Pocock, M., *Status Inequalities in Business Exchange Relations in Luxury Markets*, Promotors: Prof. C.B.M. van Riel & Dr G.A.J.M. Berens, EPS-2017-346-ORG, https://repub.eur.nl/pub/98647

Pozharliev, R., *Social Neuromarketing: The role of social context in measuring advertising effectiveness*, Promotors: Prof. W.J.M.I. Verbeke & Prof. J.W. van Strien, EPS-2017-402-MKT, https://repub.eur.nl/pub/95528

Reh, S.G., *A Temporal Perspective on Social Comparisons in Organizations*, Promotors: Prof. S.R. Giessner, Prof. N. van Quaquebeke & Dr. C. Troster, EPS-2018-471-ORG, https://repub.eur.nl/pub/114522

Riessen, B. van, *Optimal Transportation Plans and Portfolios for Synchromodal Container Networks*, Promotors: Prof. R. Dekker & Prof. R.R. Negenborn, EPS-2018-448-LIS, https://repub.eur.nl/pub/105248

Roza, L., *Employee Engagement in Corporate Social Responsibility: A collection of essays*, Promotor: Prof. L.C.P.M. Meijs, EPS-2016-396-ORG, http://repub.eur.nl/pub/93254

Schie, R. J. G. van, *Planning for Retirement: Save More or Retire Later?* Promotors: Prof. B. G. C. Dellaert & Prof. A.C.D. Donkers, EOS-2017-415-MKT, https://repub.eur.nl/pub/100846

Schouten, K.I.M. *Semantics-driven Aspect-based Sentiment Analysis*, Promotors: Prof. F.M.G. de Jong, Prof. R. Dekker & Dr. F. Frasincar, EPS-2018-453-LIS, https://repub.eur.nl/pub/112161

Schouten, M.E., *The Ups and Downs of Hierarchy: the causes and consequences of hierarchy struggles and positional loss*, Promotors; Prof. D.L. van Knippenberg & Dr L.L. Greer, EPS-2016-386-ORG, http://repub.eur.nl/pub/80059

Sihag, V., *The Effectiveness of Organizational Controls: A meta-analytic review and an investigation in NPD outsourcing*, Promotors: Prof. J.C.M. van den Ende & Dr S.A. Rijsdijk, EPS-2019-476-LIS, https://repub.eur.nl/pub/115931

Smit, J. *Unlocking Business Model Innovation: A look through the keyhole at the inner workings of Business Model Innovation*, Promotor: Prof. H.G. Barkema, EPS-2016-399-S&E, http://repub.eur.nl/pub/93211

Straeter, L.M., *Interpersonal Consumer Decision Making*, Promotors: Prof. S.M.J. van Osselaer & Dr I.E. de Hooge, EPS-2017-423-MKT, https://repub.eur.nl/pub/100819

Stuppy, A., *Essays on Product Quality*, Promotors: Prof. S.M.J. van Osselaer & Dr. N.L. Mead. EPS-2018-461-MKT, https://repub.eur.nl/pub/111375

Subaşi, B., *Demographic Dissimilarity, Information Access and Individual Performance*, Promotors: Prof. D.L. van Knippenberg & Dr W.P. van Ginkel, EPS-2017-422-ORG, https://repub.eur.nl/pub/103495

Suurmond, R., *In Pursuit of Supplier Knowledge: Leveraging capabilities and dividing responsibilities in product and service contexts*, Promotors: Prof. J.Y.F Wynstra & Prof. J. Dul. EPS-2018-475-LIS, https://repub.eur.nl/pub/115138

Szatmari, B., *We are (all) the champions: The effect of status in the implementation of innovations*, Promotors: Prof. J.C.M van den Ende & Dr D. Deichmann, EPS-2016-401-LIS, http://repub.eur.nl/pub/94633

Toxopeus, H.S. *Financing sustainable innovation: From a principal-agent to a collective action perspective*, Promotors: Prof. H.R. Commandeur & Dr. K.E.H. Maas, EPS-2019-458-S&E, https://repub.eur.nl/pub/114018

Turturea, R., *Overcoming Resource Constraints: The Role of Creative Resourcing and Equity Crowdfunding in Financing Entrepreneurial Ventures*, Promotors: Prof. P.P.M.A.R Heugens, Prof. J.J.P. Jansen & Dr I. Verheul, EPS-2019-472-S&E, https://repub.eur.nl/pub/112859

Valogianni, K. *Sustainable Electric Vehicle Management using Coordinated Machine Learning*, Promotors: Prof. H.W.G.M. van Heck & Prof. W. Ketter, EPS-2016-387-LIS, http://repub.eur.nl/pub/93018

Vandic, D., *Intelligent Information Systems for Web Product Search*, Promotors: Prof. U. Kaymak & Dr Frasincar, EPS-2017-405-LIS, https://repub.eur.nl/pub/95490

Verbeek, R.W.M., *Essays on Empirical Asset Pricing*, Promotors: Prof. M.A. van Dijk & Dr M. Szymanowska, EPS-2017-441-F&A, https://repub.eur.nl/pub/102977

Versluis, I., *Prevention of the Portion Size Effect*, Promotors: Prof. Ph.H.B.F. Franses & Dr E.K. Papies, EPS-2016-382-MKT, http://repub.eur.nl/pub/79880

Vishwanathan, P., *Governing for Stakeholders: How Organizations May Create or Destroy Value for their Stakeholders*, Promotors: Prof. J. van Oosterhout & Prof. L.C.P.M. Meijs, EPS-2016-377-ORG, http://repub.eur.nl/pub/93016

Vlaming, R. de, *Linear Mixed Models in Statistical Genetics*, Prof. A.R. Thurik,Prof. P.J.F. Groenen & Prof. Ph.D. Koellinger, EPS-2017-416-S&E, https://repub.eur.nl/pub/100428

Vries, H. de, *Evidence-Based Optimization in Humanitarian Logistics*, Promotors: Prof. A.P.M. Wagelmans & Prof. J.J. van de Klundert, EPS-2017-435-LIS, https://repub.eur.nl/pub/102771

Wagenaar, J.C., *Practice Oriented Algorithmic Disruption Management in Passenger Railways*, Prof. L.G. Kroon & Prof. A.P.M. Wagelmans, EPS-2016-390-LIS, http://repub.eur.nl/pub/93177

Wang, P., *Innovations, status, and networks*, Promotors: Prof. J.J.P. Jansen & Dr V.J.A. van de Vrande, EPS-2016-381-S&E, http://repub.eur.nl/pub/93176

Wang, R., *Corporate Environmentalism in China*, Promotors: Prof. P.P.M.A.R Heugens & Dr F. Wijen, EPS-2017-417-S&E, https://repub.eur.nl/pub/99987

Wang, T., *Essays in Banking and Corporate Finance*, Promotors: Prof. L. Norden & Prof. P.G.J. Roosenboom, EPS-2015-352-F&A, http://repub.eur.nl/pub/78301

Wasesa, M., *Agent-based inter-organizational systems in advanced logistics operations*, Promotors: Prof. H.W.G.M van Heck, Prof. R.A. Zuidwijk & Dr A. W. Stam, EPS-2017-LIS-424, https://repub.eur.nl/pub/100527

Wessels, C., *Flexible Working Practices: How Employees Can Reap the Benefits for Engagement and Performance*, Promotors: Prof. H.W.G.M. van Heck, Prof. P.J. van Baalen & Prof. M.C. Schippers, EPS-2017-418-LIS, https://repub.eur.nl/99312

Wiegmann, P.M., *Setting the Stage for Innovation: Balancing Diverse Interests through Standardisation*, Promotors: Prof. H.J. de Vries & Dr. K. Blind, EPS-2019-473-LIS, https://repub.eur.nl/pub/114519

Wijaya, H.R., *Praise the Lord!: Infusing Values and Emotions into Neo-Institutional Theory*, Promotors: Prof. P.P.M.A.R. Heugens & Prof. J.P. Cornelissen, EPS-2019-450-S&E, https://repub.eur.nl/pub/115973

Williams, A.N., *Make Our Planet Great Again: A Systems Perspective of Corporate Sustainability*, Promotors: Prof. G.M. Whiteman & Dr. S. Kennedy, EPS-2018-456-ORG, https://repub.eur.nl/pub/111032

Witte, C.T., *Bloody Business: Multinational investment in an increasingly conflict-afflicted world*, Promotors: Prof. H.P.G. Pennings, Prof. H.R. Commandeur & Dr M.J. Burger, EPS-2018-443-S&E, https://repub.eur.nl/pub/104027

Ye, Q.C., *Multi-objective Optimization Methods for Allocation and Prediction*, Promotors: Prof. R. Dekker & Dr Y. Zhang, EPS-2019-460-LIS, https://repub.eur.nl/pub/116462

Ypsilantis, P., *The Design, Planning and Execution of Sustainable Intermodal Port-hinterland Transport Networks*, Promotors: Prof. R.A. Zuidwijk & Prof. L.G. Kroon, EPS-2016-395-LIS, http://repub.eur.nl/pub/94375

Yuan, Y., *The Emergence of Team Creativity: a social network perspective*, Promotors: Prof. D. L. van Knippenberg & Dr D. A. Stam, EPS-2017-434-ORG, https://repub.eur.nl/pub/100847

Yuferova, D. *Price Discovery, Liquidity Provision, and Low-Latency Trading*, Promotors: Prof. M.A. van Dijk & Dr D.G.J. Bongaerts, EPS-2016-379-F&A, http://repub.eur.nl/pub/93017

Zhang, Q., *Financing and Regulatory Frictions in Mergers and Acquisitions*, Promotors: Prof. P.G.J. Roosenboom & Prof. A. de Jong, EPS-2018-428-F&A, https://repub.eur.nl/pub/103871

Zuber, F.B., *Looking at the Others: Studies on (un)ethical behavior and social relationships in organizations*, Promotor: Prof. S.P. Kaptein, EPS-2016-394-ORG, http://repub.eur.nl/pub/94388