Start-ups’ Choice of Strategic Response to Regulatory Constraints: An Analysis of Start-ups in the Nascent Market for Drones

Kristina Vaarst Andersen  
SDU  
Innovation and Organizational Economics  
vaarst@sam.sdu.dk

Marianne Harbo Frederiksen  
University of Southern Denmark  
Department of Technology and Innovation  
mha@iti.sdu.dk

Mette Praest Knudsen  
SDU  
Department of Marketing & Management  
mpk@sam.sdu.dk

Anders Dahl Krabbe  
University of Southern Denmark  
Department of Marketing and Management  
anda@sam.sdu.dk

Abstract

When start-ups venture into nascent markets their innovative activities risk facing constraints imposed by regulations. Yet we know surprisingly little about the determinant of start-ups’ strategic responses to regulations. In this paper, we explore which factors influence start-ups’ strategic responses to regulative constraints when commercializing nascent technologies targeted at highly regulated markets. We present an in-depth study of how start-ups in the nascent drone industry perceive the constraints they face and how this influences the strategic actions they choose as response. Based on 57 interviews with start-ups and other industry actors, we find that start-ups’ perceptions of regulatory constraints vary depending on how they interpret their market, regulative and technological environments. While some start-ups view regulation as an impenetrable obstacle, others perceive regulations as a flexible framework, which can be worked around and bended strategically or even changed. We present an empirically grounded theoretical account for whether a start-up will seek to navigate regulatory constraints strategically or whether it will tend to treat them as exogenous factors in their environment.
Start-ups’ Choice of Strategic Response to Regulatory Constraints:
An Analysis of Start-ups in the Nascent Market for Drones

Abstract

When start-ups venture into nascent markets their innovative activities risk facing constraints imposed by regulations. Yet we know surprisingly little about the determinant of start-ups’ strategic responses to regulations. In this paper, we explore which factors influence start-ups’ strategic responses to regulative constraints when commercializing nascent technologies targeted at highly regulated markets. We present an in-depth study of how start-ups in the nascent drone industry perceive the constraints they face and how this influences the strategic actions they choose as response. Based on 57 interviews with start-ups and other industry actors, we find that start-ups’ perceptions of regulatory constraints vary depending on how they interpret their market, regulative and technological environments. While some start-ups view regulation as an impenetrable obstacle, others perceive regulations as a flexible framework, which can be worked around and bended strategically or even changed. We present an empirically grounded theoretical account for whether a start-up will seek to navigate regulatory constraints strategically or whether it will tend to treat them as exogenous factors in their environment.
Introduction

Although intended for good purposes, such as public safety and environmental protection, the regulation of technology utilization often creates unintended barriers, which constrain commercialization (Gurses & Ozcan, 2015; Hargadon & Douglas, 2001; Ozcan & Gurses, 2017; Rao, 2004). Start-ups are especially exposed to such unintended barriers, because they often venture into nascent markets where rapid technological changes challenge regulators’ abilities to anticipate and timely address regulatory needs and consequences (Aldrich & Fiol, 1994; Clark, 1985; Santos and Eisenhardt, 2009). But what enable some start-ups to successfully navigate in highly regulated, nascent markets, while others struggle?

Regulatory constraints often affect start-ups negatively (Shane, 2009; Autio et al., 2014; Colombo et al., 2013; Czarnitzki & Lopes-Bento, 2013; Meuleman & De Maeseneire, 2012) and can even discourage start-ups from entering certain markets (Djankov et al., 2002; Dobbin & Dowd, 1997; Gurses & Ozcan, 2015). But regulatory constraints can also stimulate creativity and enhance innovation when firms are motivated to innovate to comply with or circumvent regulation (Aversa & Guillontin, 2018; Andrews & Farris, 1972; Baer & Oldham, 2006; Nadkarni & Barr, 2008; Rosso, 2014; van Burg et al., 2014). Hence regulation does not necessarily inhibit innovation, but it does require each start-up to carefully consider and select suitable strategic responses to regulation.

Start-ups depend more than established firms on the legitimacy associated with compliance with regulations to secure resources and framework conditions. In general, start-ups often face barriers in the form of lacking legitimacy as they navigate in ambiguous and immature market environment (Aldrich & Fiol, 1994; Santos and Eisenhardt, 2009; Navis and Glynn, 2011; Granqvist, Grodal and Woolley, 2013), and this is especially so, when they venture into nascent markets (Geels, 2002, 2004; Markard et al. 2015). Lack of regulatory legitimacy imposes regulatory constraints on start-ups.
(Suchman, 1995), which is why start-ups must aim to build legitimacy to increase their likelihood of survival and success (Zimmerman & Zeitz, 2002). Start-ups may choose different strategic actions to build legitimacy (Suchman, 1995; Zimmerman & Zeitz, 2002; Rao, 2004). The most obvious strategic actions for start-ups is conformance, to comply with the regulation, demands and expectations of the existing social structure (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Mouritsen & Skaerbaek, 1995; Suchman, 1995). But some start-ups instead choose more strategic responses to regulatory constraints (Zimmerman & Zeitz, 2002). Addressing regulation with appropriate responses is crucial for to start-ups’ legitimacy, the affiliated access to resources and ultimately to their survival and success rates (Powell & Baker, 2014; Aversa & Guillotin, 2018; Zimmerman & Zeitz, 2002). A large literature has evolved around the issues related to lack of legitimacy and how start-ups may build legitimacy, and a part of this literature even links legitimacy building with start-ups’ strategic action. But yet the question of which factors that influence start-ups’ strategic responses to regulative constraints remains neglected and we know surprisingly little about why start-ups vary in their strategic action as response to regulatory constraints.

In this paper we analyze start-ups’ strategic responses to regulation. To theorize the mechanisms underlyings start-ups’ variation in response to regulatory constraints, we study the nascent drone industry, which is an environment characterized by rapid technological development, high demand uncertainty and strict regulatory constraints. Despite the general perception among industry and policy makers that this industry will grow exponentially in the near future, at present, the industry is loaded with uncertainty in terms of regulation, demand and technology.

Based on 57 interviews with start-ups and other industry participants conducted over 18 months, we focus on changes in start-ups’ perceptions and expectations, as well as changing practice within a stable regulatory framework. We find that start-ups’ perception of uncertainty and constraints affect their innovation activity. We identify four factors influencing start-ups’ choice of strategic action in
the face of regulative constraints: Perception of demand realization (latent demand requiring cultivation), Perception of competition (urgency), Resources for influencing regulators (cognitive legitimacy of application) and time horizon of technological focus (high versus low readiness-level requiring extensive development efforts). We contribute to existing literature on the effects of constraints for innovation by analyzing the micro foundations of firm and industrial adaptation to environmental constraints. We further extend this literature with insights into how regulatory constraints simultaneously inhibit and enforce innovation activities in a nascent industry. In particular, we offer a nuanced perspective on start-ups’ strategic responses to regulation.

Theoretical Background

Even if it is not the intended purpose, regulation often constrains innovation and opportunities for utilizing innovation (Smith & Grimm, 1987; Stuart, 2010; Ramaswamy, Thomas & Lischert, 1994; Reger, Duhaime & Stimpert, 1992). Regulatory constraints can focus on economic (e.g. industry protection), social (e.g. public safety) and administrative (e.g. producer liability) aspects (Blind et al., 2004). In heavily regulated settings, such as pharmaceuticals, healthcare, defense and aerospace (Ashford et al., 1985), as well as drone technology, regulators seek to accommodate technology development and utilization, but, if this collides with public safety, they must ultimately serve the public interest (Marino et al., 2015). In this paper, we focus on regulation particular to the nascent drone industry, which combines an economic focus on stimulating a nascent technology with a social focus on ensuring a range of aspects of public safety. This regulation primarily restricts the use of drone technology, and thereby limit the commercial value of drone related innovation.

The effect of regulatory constraints for innovation activities is ambiguous (Aversa & Guillontin, 2018; Blind et al., 2004; Stewart, 2010). On the one hand, regulation of technologies can hinder
technology diffusion and thereby impede innovation and growth (Gurses & Ozcan, 2015; Hargadon & Douglas, 2001; Ozcan & Gurses, 2017; Rao, 2004), and regulatory constraints may even discourage entry into the restricted markets (Gurses & Ozcan, 2015). Policy regulations can inhibit innovation activities – especially for start-ups – e.g. by creating cost increase (Djankov et al., 2002) or reduced access to resources (Dobbin & Dowd, 1997), and regulation can block start-ups’ innovation activities (Gurses & Ozcan, 2015). In general, restrictive regulation with high compliancy costs can lead to lower innovation frequency (Bargeron et al., 2010). On the other hand, regulation may spark innovation when innovation is needed to comply with or circumvent regulation (Aversa & Guillontin, 2018). More specifically, permissive regulation (i.e. deregulation or regulation which allows for greater degrees of freedom) is found to facilitate incremental innovation along existing technological trajectories (Pilkington and Dyerson, 2006), while restrictive regulation (regulation which decreases degrees of freedom for innovative activity) increases the likelihood that firms shift technological trajectory and engage in more radical innovation (Aversa & Guillontin, 2018).

The ambiguous relationship between regulation and innovation outcomes identified in extant literature is attributed to variations in e.g. regulation intensity or direction (Aversa & Guillontin, 2018). However, the focus on type of regulation only provides insight into the structural aspect of technological transitions (Geels, 2002, 2004): Regulation sets the framework, but within that framework, organizations have opportunities for agency. New technologies can seldom be accommodated within existing regulatory frameworks, and regulators and the publics often view new technology with equal measures of awe and skepticism (Markand et al. 2015). Because regulation exists and is created in a field combining economic, political and social interests (Blind et al., 2004), changing regulation is a complex and time-consuming process.

The mis-match between the regulatory framework and technological opportunities is especially strong for new technologies. Some new technologies can borrow legitimacy from related
technological paradigms (Markand et al. 2015) or from prior solutions to the problems they address (Hargadon & Douglas, 2001), but when new technology hold potential to create new markets rather than service existing markets, it is not easy to build legitimacy and change the regulatory framework constraining the technology. However, organizations, even start-ups, choose their response to regulatory constraints, and variation in responses lead to different outcomes of varying success, and yet, we know very little about why organizations vary in their response to uniform regulatory constraints. This question is particularly interesting for startups given the limited resources available to them.

*Start-ups’ strategic actions as response to regulation*

The low legitimacy associated with new technologies and nascent markets is especially damaging to start-ups, as they possess little legitimacy in the first place (Suchman, 1995; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002; Martens, Jennings & Jennings, 2007). To gain regulatory legitimacy, start-ups must respond to the constraints of regulation with appropriate strategic actions. Stewart (2010) distinguishes between two general types of responses to regulation: compliance innovation and circumventive innovation. Compliance innovation is when firms innovate to meet regulatory standards – an example from the automotive industry is emission requirements (Stewart, 2010). Circumventive innovation occurs when firms respond to regulatory demands by working around the regulated activities or elements – an example from banking is the rise of electronic transfers as response to increased regulation of bank checks (Stewart, 2010; Silber, 1983; Kane, Baer & Pavel, 1988).

Firms’ strategic responses to regulation may also fall into categories, such as product or market choices in guise of diversification in terms of product or geographical markets (Reger, Durhaime &
Stimpert, 1992). Some firms chose to respond to regulatory demands by orienting themselves outwards and develop new products and services, others by focusing inwards on own capabilities and existing markets, and yet others by pursuing a hybrid strategy (Ramaswamy, Thomas & Lischert, 1994). In the face of regulated environments, Mahon & Murray (1981) identified that firms adopt three assumed roles which lead to different strategic responses: First, a predominantly economic role with a traditional economically oriented business strategy, which results in focus on products and related technical issues. Second, a political role associated with a political and negotiation-based relationship with regulators, which results in a balanced focus on both process (relationship with regulators) and product. And third, a social role with a strategic focus on public policy and multiple stakeholders, leading to a predominant process focus at the expense of product innovation (Mahon & Murray, 1981). Firms operating in regulated environments profit from maintaining a dual focus on both product specific and technical issues as well as the relationship with regulators (Mahon & Murray, 1981).

For start-ups, the choice of a suitable strategic response to regulation is further limited by the general shortage of available resources and by the lack of rational search mechanisms and exemplary peers (Gavetti & Rivkin, 2007). Start-ups may choose different strategic actions to build legitimacy and attain sales and resources (Suchman, 1995; Zimmerman & Zeitz, 2002; Rao, 2004). First, start-ups may choose Conformance with the regulation, which means fulfilling the demands and expectations of the existing social structure (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Mouritsen & Skaerbaek, 1995; Suchman, 1995). Second, they may choose Selection of the most advantageous environment in terms of geography or market domain (Scott, 1991; Suchman, 1995; Porter, 1990). Third, start-ups may opt for Manipulation through attempting to change the environment to increase fit with the start-ups’ business model and technology. This can be done through co-option, influence and control of processes often in collaboration with established institutions (Suchman, 1995; Dowling
& Pfeffer, 1975; Oliver, 1991; Ozcan & Gurses, 2018). Finally, start-ups may aim for **Creation** of a new normative and regulative framework. This strategic action typically calls for collaboration with industry participants and regulators (Aldrich & Fiol, 1994).

In the following empirical section, we will address the question of why start-ups choose some strategic actions over others by exploring, which factors affect the roles start-ups assume and their choice of strategic action. Extant literature provides an auxiliary framework for our focus, and based on the literature reviewed above, we focus especially on how startups’ perception of regulatory constraints and market demand may shape their choice of strategic action. The range of opportunities available to start-ups in terms of technology and resources may also influence their choice of strategic action, and we consequently focus on these aspects too in the empirical analysis.

**Methods and Data**

To answer the question of why start-ups differ in their strategic response to regulatory constraints, we undertake an inductive, qualitative study, a research design, which allows us to explore less chartered territory (Eisenhardt, 1989). The ideal empirical setting for inductive theorizing is one that provides a rich manifestation of the phenomena of theoretical interest (Yin, 2013). In our case, this means an industry characterized by demand uncertainty (Clark, 1985) and regulatory constraints (Gurses & Ozcan, 2015). The drone industry fulfills this criterion as a research setting for exploring how firms and nascent markets navigate regulatory constraints. Most firms in the industry likely have the relevant skills needed to innovate within their technology domain, but the uncertainty of the market demand creates great ambiguity in terms of which technical solutions to pursue. At the same time, legislation constrains their innovation space and limits the possibility of commercializing certain market applications. Thus, the setting of the nascent drone industry is an excellent fit for our
theoretical framework and for exploring start-ups’ perceptions of and responses to constraints to innovation in an uncertain environment.

**Research Setting: The drone industry**

A drone is a flying unmanned vehicle, which either needs a remote pilot during operation or is equipped technologically to fly autonomously. For an overview of drone terminology and types, see Hassanalian & Abdelkefi (2017). To fulfill a mission, e.g. parcel delivery, the drone itself (the drone platform) is typically equipped with additional technologies (refined camera, communication, wireless and sensor technologies). The drone platform is available in different technological designs ranging from fixed wing designs resembling airplanes to multi-rotor designs carrying a range of vertical propellers (Floreano & Wood, 2015) and a hybrid with fixed wings and vertical take-off and landing. The drone platform is a well-established and mature technology that has thus far mainly been used for military missions and lately in the toy market. The current diffusion of the technology has not yet lived up to the market potential expected by industry participants and experts (Association for Unmanned Vehicle Systems International (AUVSI), 2013). There is a wide span of possible market niches, which creates ambiguity for firms. Though policymakers in general and the Danish government in particular have been highly proactive in supporting diffusion of the technology (The Danish Government, 2016; Traffic Authority, 2015), market opportunities for drones are highly regulated. Regardless, industry experts, potential adopters and institutional actors all hold high expectations for the future potential of drone-based solutions to grow with 10b by 2035 to a size of 10% of the traditional aviation market (SESAR, 2016; European Commission, 2014).
**Data Collection**

We conducted 36 semi-structured interviews with 21 entrepreneurs from a total of 13 firms, of which 12 were start-ups, seeking to commercialize drone-related technology (See table 1 for a case overview). These companies were recruited as part of a publicly funded research and development project focused at supporting the development of drone-based solutions. The project sent out two open invitations (January 2017 and May 2017) to a membership list of the cluster management organization of the Danish drone industry. Interested firms were invited to apply for entering the project by sending a short motivation including a brief innovation pitch and information about the organization and team, the economic situation and their expectations in terms of technological development, business development and market-related aspects. All key people (typically founders and active investors) were interviewed at the start of the project, and at least one person from each start-up was interviewed again about 1½ year later.

---

**TABLE 1 ABOUT HERE**

---

These interviews enabled us to trace how the start-ups perceived the market opportunities latent in drone technology and which strategies they adopted to pursue these opportunities. As we followed the start-ups during the process of developing and commercializing their offerings, we could gain a real-time perspective on the processes and thereby mitigate the risk of retrospective bias. We further collected all publicly available information on the start-ups through webpages and social media presence. The written motivation to enter the project also provided information on the innovative idea and development of the start-up.
To gain a broader understanding of the market and regulatory context in which these start-ups operate, we interviewed a range of representatives from other organizations that were either potential customers of drone applications (17 in total) or central institutional actors in the drone market (4 in total), such as regulating bodies. These interviews were also utilized to triangulate the findings derived from the interviews with representatives from the drone firms. Finally, to gain an aggregated view on drone technology and emerging markets for drone applications, we collected and examined a range of textual sources such as reports and industry trade articles.

-----------------------------------------------------------------
TABLE 1 ABOUT HERE
-----------------------------------------------------------------

Data Analysis

We analyzed the data in accordance with grounded theorizing methodology (Glaser and Strauss, 1967), and split our analysis into the four stages:

Stage 1: Mapping the environment of the drone industry

We utilized a combination of secondary data sources and interview data with industry actors and potential adopters of drone technology to map the various regulatory elements that constrained the commercial potential of drone technology. We identified the various dimensions of drones that were regulated, such as weight allowances, geographical restrictions such as prohibition of flight in populated areas, types of controls, such as remote piloting versus autonomous controls and installment of security and safety measures. This leads us to construct four categories of regulatory constraints: individual constraints, task constraints, technology constraints and domain constraints. We analyzed how this regulation of drone applications creates uncertainty for actors seeking to commercialize drone technology. We further examined accounts of industry experts, potential
customers and institutional actors to develop a detailed understanding of how various regulatory elements constrained the application of drone technology.

**Stage 2: Identifying start-ups’ strategic responses to regulatory constraints**

We utilized the framework developed by Suchman (1995) and Zimmerman and Zeitz (2002) to systematically trace how each firm in our data set responded to regulatory constraints (see Figure 1 for an overview of this coding). We coded the various actions that start-ups did in response to regulation and their strategic rationales behind these efforts. For example, we noted that some start-ups entered a dialogue with regulators and some specifically sought out market opportunities that were less constrained by legislation. Secondly, we clustered these first order codes by examining overlaps between cognitive dimensions and strategic efforts. We clustered these by examining the presence of codes amongst the different start-ups in our sample. This outcome of this analysis was a categorization of each firm in our sample in terms of the typology proposed by Zimmerman & Zeitz (2002).

**Stage 3: Tracing start-ups perceptions of their market, technology and regulatory environment:**

To explain the strategic responses of each start-up, we coded the data in terms of four variables that were highly salient in the data from our initial coding. These variables were 1) perception of opportunities for influencing regulation, 2) perception of demand within the market niche, 3) perception of competition within the market niche and 4) perception of short and long term technological opportunities with regards to the drone application they sought to commercialize. We identified these variables for each start-up in our data set and clustered them into four categories. Two of these categories responded to regulatory constraints through a low degree of strategic action, one of the categories medium and one high.
Stage 4: constructing theoretical framework explaining variations in start-up’s response to regulation:

In the final stage of the analysis, we sat out to explain the variation in the degree of strategicness in the firms’ response to the regulative constraints that they faced. By comparing our findings of strategic responses and perceptions coded in the previous phases, we sought to identify the underlying drivers of the level of strategicness in the firms’ responses. We examined commonalities within the categories ‘low’, ‘medium’ and ‘high’ as well as differences between these. This generated a range of working conjectures from which we recoded the data to verify the explanations that we had developed. We settled on a theoretical account when no further iteration between theorizing and data analysis no longer let us to alter our explanation.

---------------------------------------
FIGURE 1 ABOUT HERE
---------------------------------------

Findings

As a nascent market, the Danish drone market is characterized by a high level of demand uncertainty. However, the start-ups in our sample interpreted these uncertainties differently\(^1\). This variety in interpretations made start-ups generate a variety of attitudes towards which market opportunities for drone technology they found worthwhile to pursue.

\(^1\) We use the term ‘start-up’ to refer the firms representing our unit of analysis and ‘entrepreneur’ to designate the individuals who acted as our primary informants representing the start-ups.
Regulatory constraints to the commercialization of drone applications

The regulation on drones is currently a national matter, as no common European or global regulation is yet in place. Each start-up must relate to the legislation of the country in which it wishes to commercialize its technology, and as the firms in the empirical material are all founded in and operate out of Denmark, we therefore carry out a detailed analysis of the Danish drone-oriented legislation. We identified four types of constraints that the drone regulation imposed upon the commercialization potential of the technology: user constraints, task constraints, technology constraints and domain constraints (see table 2 for an overview). In the following section, we will present each of these in turn.

User constraints: Parts of the regulation required professional operators to finish a drone pilot education and hold a drone certificate in order to utilize drones for specific purposes. All active drone operators had to be registered by the traffic authority when undertaking operations for commercial purposes. Task constraints: Parts of the regulation constrained which tasks could be carried out with a drone. The central example of a task constraint was the restriction of flight distance between drone and operator: Drone missions requiring flight beyond visual line of sight (BVLOS) were prohibited. However, professional drone operators could apply for an exemption and get authorization to BVLOS flights. Another task constraint prohibited a drone operator to fly more than one drone from one control station. Technology constraints: Some aspects of the drone legislation constrained drone characteristics and which technological features operators could to utilize during missions. For drone characteristics, especially weight limits provided a significant constraint. Any drone with a total weight above 25 kg was not allowed to operate in Danish airspace, which hinders e.g. delivery of large and heavy items. Another technology constraint imposed by the drone legislation was the prohibition of autonomous flight, as all drones must be directly operated by a drone operator. Fully autonomous flights were not allowed, and all operations required a person in the immediate vicinity
of the drone. **Domain constraints:** Drone regulation in Denmark is divided into two acts under Danish law depending on population density in the geographical area of operation. This distinction between urban and rural areas is due to the risk of injuring e.g. people in case of accidents. Only markets with potential for operations in low population density areas were viable, which severely constrained the potential commercialization domains for drones. It is not allowed to fly over people not part of the operation or fly over open publicly announced events without respecting a 50m distance, fly higher than 120 m above the ground, and dropping items from drones during flight.

The regulation constrains start-ups in the sense that there are innovation paths which are simply not feasible or profitable. But the potential for changes in the regulatory framework also foster a high level of uncertainty for the firms.

**Drones start-up’s strategic responses to regulatory constraints**

The regulative constraints motivated start-ups to adopt different strategic responses. These strategic responses were all manifested as variations of legitimation strategies identified by Suchman (1995) and Zimmerman & Zeit (2002), in the following, we will present these in turn.

**Conformance:** A conformance strategy is adopted by a start-up when it pursues regulatory legitimacy by showing conformity to the regulatory constraints imposed upon in its operations (Zimmerman & Zeit, 2002). In our sample, eight start-ups had adopted conformance responses, yet they could be further divided into two distinct modes, *active conformance* and *passive conformance*. Start-ups that responded to regulatory constraints through passive conformance did this either by postponing entry
or by awaiting certain developments of their ventures, such as scaling, until regulatory changes had come about.

“This system is like all the things I do. It won’t get really interesting until that you as a company get permission to fly beyond visual line of sight. Currently, very few get such permission. As I see it, it will be a matter of a few years before a broad approval is given, if you fulfil some criteria and do some paper work. Then it will get interesting when you can fly farther away than you can see. Otherwise there is not much point in it.” (SU11)

In the excerpt, a passive conformance approach is illustrated as the entrepreneur explains that he postpones his market entry until permissive regulatory changes are implemented. Because his technology requires a radical change in what current legislation allows, he shows conformance by delaying market entry. Five start-ups in our sample showed active conformance by strategically seeking to tailor the design of their market offerings to meet the requirements imposed by future regulation. The strategic response of active conformance is illustrated in the following by an entrepreneur, who developed a new drone technological architecture. He explains how he continuously try to adapt his solution based on predictions of future regulation:

“I keep an eye on what’s going on with the legislation, the European legislation, and at the moment this weight and size were designed to meet the legislation that were when we started, so I think we can… we can make the product so we can meet the… all the regulation and legislation.” (SU3)

Another variation of active conformance pursued by two start-ups were to seek to strategically or commercially benefit from the regulation, for example by offering education or training for other drone start-ups or drone users in conforming to the regulation.

Selection: A start-up adopts a Selection response, if it chooses to place its operations within certain geographical locations or within certain market domains in which the constraints imposed by regulations pose less of a challenge to their operations (Zimmerman & Zeit, 2002). Four start-ups in our sample made selection responses. Two of these start-ups did this through Initial selection when their first point of entry was determined by an effort to identify a market domain less constrained by
regulation. In the following excerpt, an entrepreneur explains how their choice of the toy and pilot education market limits the influence of regulatory constraints on their operations:

Well, it is not a big deal. … I am not afraid the drone market is not going to be shut down. That is one aspect, then there is the issue of where people can fly. But those who fly race they go out into a field or something, it is a bit underground. And those who work professionally, well they abide by the law, and then they can fly and there are drone schools and specific location and such (SU6)

The start-up offers a product used for navigation training particularly targeted at drone racing and drone pilot schools. He explains how their user base is less influenced by constraining regulation, because they solely fly in designated areas. This start-up entered the toy and education market and did not plan to experiment with entering other market niches.

In contrast, four start-ups showed continuous selection as they search for and shift to new market domains that are less constrained by the current content of the regulation. In some instances, start-ups shifted market domains in this way due to new opportunities from regulatory or technological changes. Often, however, these shifts were driven by cognitive factors such as learning in one market domain led to the identification of opportunities in another. Some entrepreneurs even reported that firms’ selection of market domains followed “fashions” within the drone industry in which the identification of new market domains ripe for drone applications triggered a surge of start-ups entering these market niches.

Manipulation: A start-up utilizes a manipulation response to regulative constraints when it strategically aims to alter the regulatory environment to its own advantage (Zimmerman & Zeit, 2002). Three start-ups in our sample performed manipulation strategies, however they differed in terms of whether they sought manipulation through a previously defined path or whether they themselves had to define the path towards manipulation. The start-ups manipulated their regulatory environment through defined paths when they could engage in a dialogue with regulators based on a shared understanding of the operation in question and a well-defined procedure for gaining exemption
for the regulatory constraint in question. The exemptions that firms tended to seek through defined paths tended to be rather incremental manipulations of their regulatory environment, such as allowances to flying in scarcely populated, but otherwise prohibited areas. These manipulations provided and sufficient expansion of the firm’s opportunity space without changing the general regulation. In addition, the fixed path manipulations are highly firm specific, and do not lead to permissive regulatory changes for other actors in the same niche.

“We are applying pressure by stating that you cannot run a business, because the legislation is not up to speed. … We always get the permissions we need… it is like it is following us… It is a dialogue every time, they don’t just close the discussion.” (SU1)

As seen in the excerpt, the start-up reported to be able to gain regulatory exemptions by entering a dialogue with regulators. These efforts imply, first that the start-up already had a positive relationship with regulators as demonstrated by them having been in contact with regulators for several years. Based on this experience, regulators tended to view the entrepreneurs as experts and were therefore more likely to trust them with the permissive regulatory changes. The start-ups which successfully attained exemptions through defined paths sought the commercialize drone applications that regulators already were familiar with. This strategic action was only an option when regulators already understood what the given operation involved, which enabled them to easier engage in a dialogue with the entrepreneurs. One firm in our sample however, was not capable of gaining exemptions through a defined path, as regulators had no established procedures for handling the kind of requests that the firm proposed. This one firm then sought to manipulate its environment through an undefined path aimed for radical changes in its regulatory environment.

“It is completely up in the air that system … nobody can tell me what to do … We are starting to find out now and will begin to put pressure on … It is not like I can just hand in a formula and then it is running. And who will I send it to, I have no idea.” (SU10)

The firms seeking to manipulate the regulatory constraints they faced, often utilized an appeal to the industrial and economic importance of the regulatory changes. As the regulators saw an interest in
facilitating the development of the industry, such appeals often landed in the favor of the start-up. The firms in our sample that utilized manipulation strategies also showed indications of selection strategies. For example, firms seeking to commercialize drone inspection applications tended to choose contexts such as areas with a minimum number of people. Within these contexts, the prospects of manipulating their regulatory environment was more realistic due to lower safety concerns.

**Creation:** Startups utilize creation strategies when they strategically seek to influence the shaping of their environment, such as norms, belief systems or infrastructure (Zimmerman & Zeitz, 2002). The one firm in our sample that had a previous history in the avionics industry was the sole firm utilizing a creation strategy. This firm strategically participated in the creation of the safety infrastructure for the drone market: “We have participated in EASA and in Nato and a range of other counseling bodies, and we have been involved in determining the requirements, so we think it will come to fit our requirements.” (SU13). To do this, they mobilized their network within the aviation field to be members of a range of councils and advisory boards, to advocate for a range of safety measures to become required; safety measures that would require a technology developed by the firm itself.

**Start up’s perceptions of their regulatory, market and technological environment**

The strategic responses that start-up's pursued were a function of how they perceived opportunities for influencing regulators, their perception of demand, competition as well as the time horizon for the technological solutions that they strived towards. By tracing start-up's perception of these dimensions, we clustered them in a new way based on second-order codes: 1) conformance (active and passive), 2) initial selection, 3) continuous selection in combination with manipulation and finally 4) creation.
Conformance (active and passive):

Regulation: The start-ups responding to regulative constraints through conformance strategies tended to perceive the regulation as highly exogenous and out of their control to influence. This perception tended to co-exist with a highly optimistic attitude towards the future evolution of the regulation. Finally, some of the firms reflected an attitude that they preferred the presence of the regulative constraints, as it bought them extra time to finish the development of their technological solution:

“We are still optimistic, but we realized that it takes more time [to develop the app] than we had expected. On the other hand, it is maybe fortunate [that the legislation in not in place]; it gives us more time. Because when they bring it [the legislation] into effect, there will be more [firms] who see the opportunities and start programming. … In that sense, we might benefit from the time it takes.” (SU8)

In the excerpt, the entrepreneur reports how he perceives the regulations as beneficial for him, as it guards his market niche from entrants until his start-up is ready with their technological solution. Because of the current high level of regulatory uncertainty, he believed that it lowered potential entrants’ likelihood of becoming future competitors. Demand: The start-ups showing conformance strategies tended to see demand as readily present and only awaiting to be reaped. In the following, an entrepreneur expressed his highly optimistic prognosis for the demand for drone applications: Drones are totally explosive at the moment. If can catch on, then it will be enormous. … It is just happening, the opportunities for applying them explodes here, there and everywhere (SU8). In the excerpt, the entrepreneur states that the demand for drone applications is readily present, it is only a matter of getting ready with the adequate solution to reap the commercial gains. Competition: Start-ups within the conformance category tended to perceive competitive pressure as very low. As they tended to regard their innovations as highly novel, they also emphasized how no other companies were about to enter the market with anything resembling theirs: I have not found others who do it in this way…. [sums up drone application] … That I have not seen elsewhere. If you look at it in this context, then it is very novel. (SU11). In the excerpt, the entrepreneur expects low competitive
urgency due to the novelty of his solution. **Technology:** The technological horizon of start-ups within the conformance group tended to have a highly ambitious and long-term technological horizon. This is reflected in the following explanation of an entrepreneur of how scaling their business model will be highly dependent upon autonomous controls:

I think that there will be a shift now towards more autonomous flights. If we can catch on to it, and turn it this way [creating a need for their flight planning system], be a part of it, together with the right actors … I don’t think that pilots in the future will be pilots … [explains a new drone he used for a test] … most of what I filmed was automatic. (SU8)

This illustrates a tendency amongst start-ups responding through conformance. Often, these start-ups required flight beyond visual line of sight or autonomous controls, which at the time of the study had a low level of technology readiness.

*Initial selection:*

*Regulation:* The start-up that responded to regulatory constraints through initial selection, tended to only perceive a low level of opportunities and felt little incentive to seek influence on regulators. Instead of seeking to strategically address regulation, they had opted for a market domain where the regulation only minimal constrained their operations. *Demand:* The start-up that responded to regulatory constraints through initial selection perceived demand for their market offerings as present, yet transient. This demand was present, as customers tended to represent an early niche in the diffusion of drone technology, namely hobbyist use as a toy market or for drone racing.

In terms of marketing we bet on these drone racers because they are easy to address… It is there you find the fascination and the feeling of being a pilot. When we then get out there in the longer run, then we will be addressing the more technical ones, you can say that the racers, they will be creative out on a corn field anyways. With regards to the professionals… this will play a part in setting the standards for how you educate pilots. (SU6)
This demand was also transient, as it depended on a preliminary stage in the evolution of drone technology focusing on piloting based on manual flight control. This is seen when the entrepreneurs were asked how the emergence of autonomous flight controls might influence their business: “Our target audience are those who are interested in being in control themselves, playing with it and become better. So obviously, when it becomes more GPS controlled, it will clearly be a challenge for us.” (SU6). The entrepreneurs recognized that their solution would become less relevant for users as drones increasingly would possess autonomous controls. *Competition:* Start-ups responding through initial selection experienced high competitive urgency. This was because their market demand was actually present and ready for exploitation: “There are two competitors who have made something nearly similar, but the segment is there” (SU6). Because the segment for manual drone navigation training and drone racing was well established, other firms had entered it with market offerings resembling the start-up in our sample. *Technology:* The start-ups responding through initial selection tended to have a very short-term technological horizon, with their future development plans amounting to a range of incremental and service innovations in their already existing market offering. Often, the long-term technological potential of the drone platform even held threats to the very foundation of these firms’ existence.

*Continuous selection and manipulation:*

*Regulation:* The firms combining continuous selection with manipulation took a more strategic approach. Through a combination of selecting realistic, yet high-potential market domains with incremental manipulations of the regulation through exemptions, these start-ups identified and exploited a range of opportunities within the extant regulation:
“Other business opportunities will emerge and follow the development [of the legislation], but currently this is our focus. I can see in 1.5-2 years, we will see some changes in the legislation, but it feels as if they are coming” (SU1).

It is essential for our setup for inspection of windmills [autonomous flight]. It is the only thing that really matters. All the other stuff [inspection tasks utilizing manual flight] that is areas of interest and possibilities that it is not as such necessary to use a drone for. (SU2)

In the excerpts it is seen how these start-ups continuously oriented themselves towards which business opportunities that resided within the current form of the regulation. However, often these opportunities were merely used as stepping stones until the more ambitious technological solution with higher potential became possible. Demand: The start-ups within the continuous selection and manipulation group tended to perceive demand as latent in the sense that it required a lot of cultivating. In the following excerpt, an entrepreneur with an anti-drone security system explains how he perceives a need to gradually cultivate demand by fostering acceptance of the technology:

“Technology acceptance … that can slow our entry to the market down and reach our goal … I think our greatest requirement is to find the right way through and be allowed to do some tests. After that we can get it accepted as a general service. Then we can say that it has an autonomous component, but we have made sure that it is functioning. Nobody needs a permission because they represent a prison or similar. But if the person with a manor wants one, then they can roll it out there too.” (SU7)

The entrepreneur explains that their main challenge is societal acceptance of their solution. However, they strategize that if they first conquer less constrained markets, such as prisons, other, more challenging market niches, such as private guard systems, will gradually follow. Competition: The firms utilizing continuous selection in combination with manipulation, tended to perceive competition to be present, however not as a severe threat, because they had more experience within their market niche as well as strategically important exemptions from the regulation.

I don’t think so in terms of inspection. I wouldn’t really know who to mention, because I don’t really feel that they do it properly. … It is difficult to say [how many close competitors they have] because many do it as a hobby (SU1).
As expressed in the excerpt, the start-up operates in a market niche with emerging competition. However, through continuous selection of market domains, from media production to inspection tasks, the start-up has required a stronger market position and a more mature organization. 

**Technology:** The start-ups that responded through continuous selection and manipulation worked towards highly ambitious technological horizon with a low level of readiness while seeking to commercialize more immediate technological solutions with a high level of readiness:

“Manual and visual [manual control and within visual line of sight]. That is what they want to begin with. That covers 50% [of the customers’ need]. … But we spend too much time with manual flight … it must be brought down and that it why it must become autonomous [the control of the drone].” (SU2)

As illustrated in the excerpt, typically, these start-ups commercialized solutions solely requiring manual controls and flight within the line of sight of the operator. However, simultaneously to this, they worked towards reaching a highly novel technological solution utilizing autonomous control and flight beyond visual line of sight, a solution with potentially much higher customer value and scaling potential.

**Creation:**

**Regulation:** The firm in our sample reflecting a creation response, was highly attentive towards developments within legislation. As illustrated in the excerpt, they projected that the trend would move towards increased regulation which created a market opportunity for their technological solution:

I can see that they have discussed it in the US and in Europe they are soon going to decide that drones must have electronic ID. … I have from our collaborators in Washington that on this point, the Americans are on their way to electronic ID like us in Europe” (SU13)

In the excerpt, it is seen how the entrepreneur predict that the requirements towards registrations of drones will increase which will cultivate a demand for the kind of digital identification systems that
they offer. **Demand:** The firm in our sample seeking to strategically influence and define its regulatory environment, perceived that demand for their market offering would increase with the general diffusion of drone technology: “I think that drones … will get bigger and bigger, both in size but also in numbers. This means that the market potential over the next 50 years in my mind is infinite” (SU13). Because further diffusion of drone technology likely would require better registration and identification of drones and their operators which in turn increased demand for their market offering.

**Competition:** This firms’ perception of its competitive environment was less oriented towards other firms and more towards international government actors. In the following excerpt, one entrepreneur states that the nobody within their geographical area and market niche operates within the same technological domain as them: “If you look at the competition … who else works with ID systems in Europe? I don’t know” (SU13). In contrast, the competitive threats that this firm experienced concerned differences between government actors:

“We have chosen to piggyback on the Danish Government. But their agency doesn’t partipate much in international meetings, why we are always a step behind. But the Germans, French and Italians… they have a step ahead. That is clearly our competitive challenge.” (SU13)

Because the market potential of the firm was dependent upon actions from the Danish government, they were troubled that governments who were more influential in shaping international drone regulation would pose a threat to their market potential. **Technology:** The firm in our data that utilized a creation strategy did not have seek to commercialize any technology with a low level of readiness carrying extensive development efforts. Rather, they sought to commercialize a technology well known within the field of avionics: “The foundation for this goes back to 1900, in the start 90’s…. It is the same principle, completely… It is not a new technology for us” (SU13). In spite of the fact that the technology as such was readily available, commercializing it required extensive efforts in cultivating demand through influencing the development of the regulatory infrastructure of the drone industry.
Explaining variations in start-ups’ responses to regulatory constraints

Why did start-ups vary in terms of how strategic they were in their response to the regulatory constraints that they faced? By tracing start-ups, perception of regulation, demand, competition and their own technology, we identified patterns in why start-ups opted for certain responses to regulatory constraints. We categories different responses that were as low, medium in high in terms of how strategically they responded. The responses categorized as low were conformance and initial selection, medium were continuous selection and manipulation and finally creation was high. In the following we will review each of these in turn.

Low (Conformance and Initial Selection)

The firms that were minimally strategic in their response to regulatory constraints, tended to perceive regulation as an exogenous factor in their environment outside of their immediate control. Several of these firms, either were unconcerned with regulation, due to the particular market niche they had selected (initial selection) or they even saw the constraining effect of the regulation on their market niche as a strategic advantage:

“From my perspective, it is almost enhancing my competitiveness that the legislation is a bit vague and undesirable with regards to how drones are allowed to fly. Because it has led to few [firms] focusing on the opportunities that eventually will come when the legislation has become freer … I imagine that when it eventually will be opened up, when some more specific rules show up for what is allowed, then more companies will focus on it. … But currently I feel that we are somewhat alone.” (SU11)

In the excerpt, the inventor explains why he regards the presence of the regulation as a competitive advantage. This entrepreneur perceived market demand as present and ripe, yet his technological solution had a very low level of readiness and the prospect of market launch for out in the horizon.
Due to this, he perceives the regulatory uncertainty in the market as beneficial because it keeps out entrant while he seeks to finish the technology required for his market offering.

Other firms in the low category did not seek influence on the regulation because they had opted for a market niche in which the regulation provided minimal constraints. Such market niches, such as navigation training, however were also characterized by presently available demand and were based solely on technology with a high level of readiness. In contrast, the firms showing a medium strategic response to regulatory constraints, were more hindered by regulatory constraints, because the technology they aspired to and the demand they sought to address were not readily available and therefore less well known by regulators.

Medium (Continuous selection combined with manipulation)

The firms in the ‘medium’ category particular differed from the ‘low’ category by seeking to enter market niches in which demand required more cultivation and where the current stage of the technology was only perceived as a stepping stone towards more ambitious solutions with a lower level of technological readiness. Due to this low level of understanding amongst customers and regulators of the technological solution they offered, they opted for a more strategic response than merely conformance or initial selection.

“It is because we have been going for so long. We have been involved in starting it all in Denmark, and we were sitting in with the transport authority since the beginning, because they had nobody who knew anything about drones. They did not know what it was, and it was almost as if we had to tell them what a drone was and tell them how the rules had to be in Denmark for it to be possible to carry out missions” (SU1)

However, the start-ups in the ‘medium’ category tended mainly to be focused upon individual exemptions, rather than broad changes in the legislation. The firms in this category, tended to benefit
from the regulation also, but in a distinct way than the firms showing a conformance response. For the firms showing continuous selection and manipulation, the presence of the regulation enabled them to differentiate themselves from competitors by having certain exemptions that others did not. This use of the regulation as a source of competitive advantage is reflected in the following excerpt:

"I think it is because they don’t really want to. I think that many find that legislation is boring. It is some irritation thing that you just have to conform to because the traffic agency says so. … Instead of asking, how can we use this as an asset. I mean, how can we use it to do something that others don’t do. … All the tasks that we have done ourselves have been because we used the legislation, so we have some advantages that others don’t. Or rather, perhaps they could, if they were to carry out the work." (SU12)

In the excerpt, the entrepreneur describes a tendency within the drone industry to respond to regulation through conformance. However, he emphasizes that opting for a more strategic response and discovering openings in the regulation as a way to get customers unreachable for start-ups seeking to navigate around of the regulatory constraints rather than within them.

**High (Creation)**

The firm in our data set that were the most strategic in its response to regulatory constraints, was characterized by considerably experience and knowledge in aviation regulation. Furthermore, it based its business model on certain developments in the regulatory infrastructure of the industry

Then you have professional flights, here we have attained a position … through this we have been allowed to participate and are given all the documents to deliver input. You have 110 individuals in Europe who are developing this … The deal is that the European Commission must make a decision… It will likely turn out as expected … everything [all drones] above 250 grams must fly with an ID system. … Which means that a lot of people in the world will need to follow the rules. … It will cost a lot of money… That is why politicians see a need to identify easier solutions to how and when you can require it (SU13)

Due to the intimate connection between regulatory changes and creating market demand, the firm did not solely seek to manipulate regulatory constraints, but rather sought to influence the creation of the
general regulatory infrastructure. Because their business model required that their technological solution played integral part in international drone regulation, their pursuit of market opportunities required a highly strategic response through a creation approach.

**Discussion**

We sat out to understand which factors influence start-ups’ strategic responses to regulative constraints when they seek to commercialize nascent technologies in highly regulated markets. Through our inductive study of 13 drone firms, we identified four characteristics, which influenced start-ups' choice of strategic response to regulative constraints: the start-ups’ perception of opportunities for influencing regulators, their perception of demand, their perception of competition as well as the time horizon for the technological solutions that they strived towards.

We find that start-ups perceive regulatory constraints and uncertainties very differently. At the micro level of the individual start-up, they experience constraints as restricting their opportunities to create profitable innovations and perceive the ambiguity of the regulatory environment as an unwelcome uncertainty. The start-ups experience that they operate under a high degree of market uncertainty, but their strategic responses to this situation are very different. The legislation becomes a fix point for start-ups’ navigation in their uncertain environment. Our results support that start-ups choose among the strategic actions identified by Zimmerman & Zeit (2002). We further explored the relationship between start-ups’ perception of their environment and variations in their choice of strategic action. First, we found that start-ups, which either perceived regulation as an exogeneous factor or expressed little concern for regulation tended to choose strategic actions along the lines of Conformance and Initial Selection. Second, we found that start-ups' targeting markets perceived as characterized by low technological readiness and unrealized market potential tended to choose a combination of
Continuous Selection and Manipulation and their preferred strategic action. Finally, one start-up division of an established firm, which held experience, knowledge and connections in the field pursued strategic action along the lines of creation.

Compared to previous studies of start-ups' need for legitimacy (Suchman, 1995; Zimmerman & Zeitz, 2002) and studies of the relationship between regulatory constraints and innovation (Stewart, 2010; Leea, Velosob & Hounshell, 2011; Aversa & Guillontin, 2018) we contribute with an explanation of why start-ups vary in their strategic response to regulatory constraints. And the insight from our analysis is the notion that start-ups' perception of their environment, especially regulatory constraints, influence their strategic response to regulation. While extant theory (Gurses & Ozcan, 2015; Ozcan & Gurses, 2017) tends to assume that firms’ response to regulation is limited to the entry/non-entry decision or focus on the relationship between strategic action and legitimacy (Zimmerman & Zeitz, 2002), we find that the firms' responses to regulation are more complex and contingent upon their interpretation of the regulation and expectations for future market potential.

Our explanations of start-ups’ use of selection and manipulation strategies extent the findings of Audia & Goncalo (2007), who find that start-ups at times navigate constraints by seeking new opportunities, as well as Moreau & Dahl (2005) and van Burg et al. (2014), who show that resource constraints can at times direct start-ups’ attention toward opportunities. This does not imply that start-ups are attracted by the constraints themselves, but rather that a bounded innovation space improves their opportunity recognition within the constrained field (Hoegl et al., 2008). Seeking influence on regulators through manipulation or creation strategies is not unknown to extant research (Gurses, & Ozcan, 2015). What is interesting though is that given the size of these start-ups versus the regulatory bodies and the public interest in general, it is counter intuitive that these firms should attempt to seek influence and reduce the constraints they face. One potential explanation could be that start-ups receive clear signals that regulators are strongly inclined in their favor. The optimism regarding the
future potential of the drone industry thus fertilizes the ground for a self-fulfilling prophecy: Because start-ups, industry participants and regulators alike all expect the industry to prosper in the near future, rules are bent, and regulations waived, which in turn increases the likelihood that start-ups and the industry will succeed.

The constraints imposed by legislation where only partially exogenous to firms; as many of the start-ups in our sample perceived them as an environmental factor they could influence. The relevance of this finding extends to the methodological approach of using regulatory changes as exogenous shock: if even small start-ups can change the regulatory framework they face, we must suspect that larger entities, lobbyism etc. is even more efficient in affecting regulatory frameworks.

This paper contributes to extant literature on the relationship between startups’ constraints, perceived environment and strategic action in several ways. We contribute by analyzing the micro foundations of industrial adaption to environmental change and explore how regulatory constraints simultaneously inhibit and enforce innovation efforts in an emerging industry.

We found that firms entered the drone market due to great expectations about the promise of the technology, despite a severely uncertain and constrained market environment. Our findings suggest that policy constraints on technology applications do not necessarily kill entrepreneurial activity. In contrast, we find that policy regulation that constrains commercialization can foster innovation by focusing efforts and investments within specific market niches. As a boundary condition for these mechanisms, the effect we observed was likely dependent upon the condition that start-ups maintain great expectations towards future market opportunities by forcing entrepreneurs to maneuver around regulative constraints through focus on specific market applications.

One limitation to our study is that the young age of the start-ups limits the time period for data collection. For many of the start-ups, the studied period covers the majority of their existence, but
yet, the period is not sufficiently long for us to study if they change their perception of policy constraints, and if such a change triggers change of strategies. Another limitation is that this study is limited to one industry and we expect our findings to be at least partly driven by the specific conditions of that context. One interesting avenue for future research would be to follow case companies even longer than we had opportunity to, in order to capture development and outcomes. Another fertile path is corresponding analyses of industries and settings with varying degrees of uncertainty. This would help refine our understanding of how high versus low uncertainty affects start-ups’ perception and strategic response to regulatory constraints. Finally, an exogenous shock in the guise of major regulatory change would be interesting to analyze, both with a longitudinal qualitative study and with a quantitative experimental set up.

Conclusion

In the analysis, we identified four characteristics, which influenced start-ups' choice of strategic response to regulative constraints. The strategic actions of Conformance and Initial Selection were chosen by the start-ups, which either perceived regulation as an exogeneous factor or expressed little concern for regulation. The strategic action of Continuous Selection combined with Manipulation was chosen by start-ups' targeting markets perceived as characterized by low technological readiness and unrealized market potential. And finally, the strategic action most resembling Creation was chosen by one start-up division, which held experience, knowledge and connections as it was part of a more established firm. These findings extent those of the existing literature by providing an answer to the question of how start-ups chose their strategic response to regulatory constraints.
References


Shane, S. (2009). Why encouraging more people to become entrepreneurs is bad public policy. Small business economics, 33(2), 141-1


<table>
<thead>
<tr>
<th>Acronym (SU = start-up)</th>
<th>Year of establishment</th>
<th>Focus/offering</th>
<th>Development stage Spring 2017</th>
<th>Development stage October 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>SU1</td>
<td>2012</td>
<td>Infrastructure inspection</td>
<td>Manually operated solution available</td>
<td>Semi-autonomous solution available</td>
</tr>
<tr>
<td>SU2</td>
<td>2016</td>
<td>Infrastructure inspection</td>
<td>Manually operated solution available</td>
<td>Manually operated solution available</td>
</tr>
<tr>
<td>SU3</td>
<td>2017</td>
<td>Development of drone Energy production by drone Operating system for drone missions Drone flight tracking and training Counter drone system App for drone mission planning</td>
<td>Functional model</td>
<td>Proof of concept; flying semi-autonomously</td>
</tr>
<tr>
<td>SU4</td>
<td>2016</td>
<td>Energy production by drone Operating system for drone missions Drone flight tracking and training Counter drone system App for drone mission planning</td>
<td>Functional model</td>
<td>Proof of concept; flying semi-autonomously</td>
</tr>
<tr>
<td>SU5</td>
<td>2017</td>
<td>Functional model</td>
<td>On the market; semi-autonomous flight</td>
<td></td>
</tr>
<tr>
<td>SU6</td>
<td>2016</td>
<td>Functional model</td>
<td>On the market</td>
<td></td>
</tr>
<tr>
<td>SU7</td>
<td>2013</td>
<td>Functional model</td>
<td>On the market</td>
<td></td>
</tr>
<tr>
<td>SU8</td>
<td>2017</td>
<td>Functional app</td>
<td>Minimum viable product being tested on the market</td>
<td></td>
</tr>
<tr>
<td>SU9</td>
<td>2016</td>
<td>Drone as calibration tool Cloud-based drone data platform Collection of environmental data by drone</td>
<td>Software under development</td>
<td>Proof of concept and almost ready to go to market; semi-autonomous flight</td>
</tr>
<tr>
<td>SU10</td>
<td>2014</td>
<td>Ready for market</td>
<td>On the market</td>
<td></td>
</tr>
<tr>
<td>SU11</td>
<td>2012</td>
<td>Software and hardware under development</td>
<td>Proof of concept</td>
<td></td>
</tr>
<tr>
<td>SU12</td>
<td>Unknown</td>
<td>Film production</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>SU13*</td>
<td>1978, drone unit in</td>
<td>Regulation of airspace</td>
<td>Ready for market</td>
<td>Not relevant</td>
</tr>
<tr>
<td>Type of regulatory constraint</td>
<td>Definition</td>
<td>Empirical example of constraint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------</td>
<td>---------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User constraints</td>
<td>Constraints on which individuals are allowed to use the technology</td>
<td>Certification: To operate a drone for commercial purposes, obtaining a certificate is required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task constraints</td>
<td>Constraints on which tasks users are allowed to have the technology perform</td>
<td>BVLOS: flying Beyond Visual Line of Sight (BVLOS) is still only possible under dispensation and in restricted areas. Many missions need BVLOS permissions to fully reap the potential of their drone-based mission. Swarms: performing missions with swarms are not allowed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology constraints</td>
<td>Constraints on which characteristics and technological features products are allowed to carry</td>
<td>Drone characteristics: a smaller drone is only allowed up to 25 kg. This may be a restriction, since for instance delivery of goods may demand more than 25 kg in total. Autonomous flight: autonomous flights are not allowed. The drone must be in direct control by the drone operator.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain constraints</td>
<td>Constraints on flying in built-up areas</td>
<td>Populated areas: missions are not allowed in populated areas and people within 50 m of the drone must be part of the operation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FIGURE 1

Coding overview deductive identification of strategic responses

- **Conformance**
  - Active conformance
  - Passive conformance

- **Selection**
  - Initial selection
  - Continuous selection

- **Manipulation**
  - Defined path manipulation
  - Undefined path manipulation

- **Creation**
  - Participating in infrastructure creation

**Tailoring market offering to meet regulative requirements**
- Anticipating future regulation to guide developmental efforts
- Postponing market entry till permissive regulative changes
- Awaiting scaling till permissive regulative changes
- Choosing a single unconstrained market niche
- Continuous experimentation with less constrained market niches
- Seeking defined regulative exemptions through established procedures
- Seeking defined regulative exemptions through relationship to regulators
- Seeking undefined regulative exemptions outside of established procedures
- Lobbying for standard implementation in drones of own technology