Entrepreneurial Space and the Freedom for Entrepreneurship: Institutional Settings, Policy and Action in the Space Industry

Research summary: Anticipating that innovation nurtures entrepreneurship, we began an extended case study of an innovative start-up in the space industry. We quickly saw that institutions imposed formidable barriers to implementing entrepreneurship from innovation. Curious about how, why and the extent of this situation, we widened our study to other start-ups, CEOs of existing businesses, an incubator, a technology transfer office and key influencers in large space companies and agencies. We found that institutions and policies had, in effect, shrunk the entrepreneurial field, leaving little room for enterprise. Conceptualizing from this, we propose the institutions create an "entrepreneurial space." Theoretically, we explain how this concept of an entrepreneurial space can be usefully applied in other contexts.

Managerial summary: The space industry is extremely innovative. It is also dominated by two powerful incumbent firms and a third that is highly regulated. This research examines how entrepreneurship in the space industry is shaped by institutions, and what this implies for the freedom to be entrepreneurial. We investigate this question in the French European context. We find that while the industrial context and institutions had completely pushed entrepreneurship out of the upstream segments it flourished in the margins of this industry. The upstream segment is not at all entrepreneurial; downstream is the entrepreneurial milieu of the space industry. We recommend that policymakers (1) strengthen private-public-partnership arrangements; (2) implement policies to attract venture capitalists to transform and reinvigorate the upstream segment; and (3) design specific incubation mechanisms for space start-ups.

Keywords: Space industry, innovative entrepreneurship, policy and institutions, entrepreneurial space, institutional theory.

1. INTRODUCTION

We are interested in determining how entrepreneurship in the space industry is enabled and constrained by institutions, and what this implies for the freedom to be entrepreneurial. The space industry is perceived as very innovative, leading us to expect it to be an environment conducive to entrepreneurship. Yet, the space industry is highly regulated by institutions (Pérez Dos Santos Paulino & Cambra-Fierro, 2017). There is little research examining how institutions impact on entrepreneurship at an industry level (Urbano, Aparicio, &Audretsch, 2019; Welter, 2011; Whetten, 1989), we know from work in other contexts that institutions tend to form the rules of the innovation game (Acs, Audretsch, Lehmann, & Licht, 2017). Studying entrepreneurship in the context of the space industry offers the opportunity to deepen our understanding of industry-specific conditions that form the rules of the game for innovation—not only how the game is played, but also the size of the playing field. In turn, we conceptualize from these processes to offer broader theory, explaining how institutions determine the entrepreneurial field.

The institutional literature provides our theoretical framework. The concept of institutions offers a concrete, tangible way to capture the structures that form the industrial context in which firms operate. North (1990, 1991) showed how regulations, law and the like can be understood as formal institutions. In contrast, cultures, values and practices can be seen as informal institutions. Together, formal and informal institutions offer a structural map of the space industry territory, the context that firms encounter and negotiate, as well as the policies, rules and norms that influence the ways in which they behave.

We view entrepreneurship as "*judgmental decision making that takes place in a market setting under uncertainty. Entrepreneurs combine heterogeneous assets, which differ in their attributes, and deploy these assets within a firm to the production of new offerings they hope will satisfy customer wants, generating profits*" (Foss & Klein, 2020, p.368). Innovative entrepreneurship emphasizes novel products, services, production methods and innovative business models. It aims to produce economic returns from inventions and innovations.

Entrepreneurial opportunities are exploited through existing firms or through the creation of new ventures (Shane & Venkataraman, 2000). The extent to which incumbents, rather than new firms, fill the market gap created by technological innovation depends on a variety of elements, some of which can be influenced by governmental intervention. Put differently, institutions influence entrepreneurship and set out the "rules of the game" (North, 1994; Williamson, 2000) that shape enterprise or even prevent it.

We took a novel approach to building understanding of how entrepreneurship in the space industry is enabled and constrained by institutions, and what this implies for the freedom to be entrepreneurial. Our ten-year study originated in an extended case study of a smaller entrepreneurial space industry firm. Because our analysis suggested interesting and unique features in the space industry, we extended the study to include other start-up founders and CEOs of existing businesses. We then tapped into the perceptions of business angels and incubator managers. To deepen these different understandings, we interviewed key influencers in large space companies and space agencies. Together, these data built up an appreciation of how different space industry stakeholders make sense of and inform their organizations' entrepreneurial role and practices.

While the space sector is extremely innovative (OECD, 2016), we found that interaction between its components, such as policies, rules, market structure and powerful incumbent firms, hinders enterprising behavior and pushes entrepreneurship out to the boundaries of the space industry. Indeed, our findings demonstrate that the main upstream players are not entrepreneurial at all. Moreover, we see that the ability of smaller but innovative upstream players to be entrepreneurial is constrained, or even squeezed out, by the main players. The upstream space industry is a closed space, highly regulated, hierarchically constituted, managed and controlled with no room for enterprising behavior. It is open to innovation, but only on main upstream players' terms. Institutions have narrowed the opportunity space, leaving no room for enterprise.

Conversely, the downstream segment of the sector, outside the industry itself, is a fertile entrepreneurial milieu where innovations are found and have much broader application. Many players compete and collaborate to generate value by applying innovations that have been developed upstream by and for the main players. Different policies, different drivers, different logics and different organizations mark out a very different institutional environment.

Although considered to be one single industry, these contrasting contexts suggest that two very different systems are in play—explanations of how things work upstream have little explanatory power downstream. We demonstrate that upstream offers a mature field, where institutions are established and entrepreneurial opportunities are seized by dominant actors, who have access to, and can monopolize, key resources. Downstream is more an emerging field with less clearly established institutional rules (Aldrich & Fiol, 1994; Lounsbury & Glynn, 2001; Stone & Brush, 1997), and where resources tend to be distributed among disparate groups of entrepreneurs with more freedom for enterprise (Maguire, Hardy & Lawrence, 2013). We note, albeit at industry level, conceptual similarities with Audretsch and Thurik's (2004) account of the differences between a managed economy and an entrepreneurial economy. The managed economy is largely determined by the requirements of large-scale production. In contrast, the entrepreneurial economy incorporates an extra production factor: entrepreneurial capital. We see theoretical parallels at industry level in the space industry. Upstream is managed, but downstream is open, entrepreneurial and opportunity driven.

Through analyzing this unusual situation, we propose the concept of entrepreneurial space, the extent of room for entrepreneurial change. We saw how this space was formed by institutional logic and purpose and circumscribed by reducing risk and uncertainty. Nonetheless, we saw how innovations seemed to carry inherent vitality, entrepreneurial potential with agency for change. It was this innate entrepreneurial property that burst out of the institution space, overflowing downstream into a more open, opportunistic and flexible entrepreneurial space. It is here that space-led innovations gain footholds and purchase. This entrepreneurial space is much larger and better able to tolerate the unpredictability and inherent risks of entrepreneurial change.

In terms of its contribution to the literature, our analysis illustrates the boundaries of entrepreneurship. Moreover, we believe the concept of entrepreneurial space can generate explanations of entrepreneurial practices in different contexts. For example, it can help explain the practices of female entrepreneurs in conservative societies. It is useful for appreciating how policies might work. For instance, if we apply it to burgeoning ideas like the "entrepreneurial university", it becomes clear how institutional logic, with its conservative emphasis on stability and conformity (Levy and Scully, 2007), necessarily diminishes innovative power and agency in entrepreneurial change. We suggest the concept might also be a handy tool for different levels of analysis—the firm, the industry or the region. Alternatively, we might profitably apply it to conceptual categories such as gendered, rural or social entrepreneurship.

This special case also contributes to a broader conception of entrepreneurship itself. It demonstrates that entrepreneurship is more than innovation, and is not bounded by economic or technological functionality. Instead, we can usefully conceive entrepreneurship as an engine of change. Change is both the milieu for and outcome of entrepreneurship (Brazeal & Herbert, 1999; Battilana, Leca, & Boxenbaum, 2009; Smallbone & Welter, 2012). Entrepreneurship can harness change but as Dimov (2011) and others (Anderson, 2015; Dushnitsky and Mutusik, 2019) note, it is experimental change. Entrepreneurship thrives on uncertainty but the entrepreneurial process uses trial and error experimentally, with unpredictable outcomes. In other words, entrepreneurship generates change but with uncertain consequences. Our analysis shows how some institutions shun risk and uncertainty (Tolbert, David, & Sine, 2011), restricting entrepreneurship to control change. We see ramifications for policy in these tensions. Policies that assume entrepreneurship is a universal good thing will struggle to help implement innovation if institutional structural constraints are not carefully considered and addressed.

2. THEORETICAL BACKGROUND

2.1. Institutions and entrepreneurship

The development of entrepreneurship varies according to several factors (Urbano, Aparicio & Audretsch, 2019). However, understanding what lies behind these factors and their unfolding economic consequences is still debated (Baumol & Strom 2007; Carlsson, Acs, Audretsch, & Braunerhjelm., 2009). Nonetheless, the institutional environment in which entrepreneurs operate (Aidis, Estrin, & Mickiewicz, 2008; Alvarez, Urbano, Coduras, & Ruiz-Navarro, 2011; Bosma, Content, Sanders, & Stam, 2018; Urbano & Alvarez, 2014) provides some explanation (Williamson, 2000). North (1994) and Williamson (2000) suggest that it is the interaction between the rules of the game, the play of the game and organizations that shapes the institutional evolution of entrepreneurial engagements, where entrepreneurs are players, constrained, enabled, guided, even evaluated, by the institutional frame (Nooteboom, 2002, p. 34).

From an entrepreneurial perspective, the field of institutional economics, with seminal contributions from North (1990), Scott (2013) and Williamson (2000), argues that formal rules (e.g., constitutions, laws, and regulations) and informal rules (e.g., norms, habits and social practices) are key in shaping entrepreneurial activities (Fini, Fu, Mathisen, Rasmussen, & Wright, 2017). Studies show that, as antecedents of entrepreneurship (Bruton, Ahlstrom, & Li, 2010), institutional factors drive the conditions for entrepreneurship (Su, Zhai, & Karlsson, 2017). Distinguishing between formal factors (e.g., procedures and costs to create business, support mechanisms such as incubators, accelerators) and informal factors (e.g., entrepreneurial culture, attitude towards entrepreneurship, belief systems, social norms and cognitions) shapes how entrepreneurship plays out. Baumol (1990), arguing that institutions drive the allocation of entrepreneurial talent, envisioned an integrated model in which institutions are the fundamental cause of growth, moderated through a proximate cause, which is entrepreneurial activity. Institutions can encourage new firm foundations by providing an appropriate environment or by hampering them by imposing barriers (Yip, 1982; Welter & Smallbone, 2011; Urbano *et al.,* 2019). In addition, the institutional environment defines and limits entrepreneurial opportunities, and so affects the rate and size of new venture creation (Aldrich, 1990; Gnyawali & Fogel, 1994; Hwang & Powell, 2005). Accordingly, we argue that institutions form the structure for entrepreneurial agency, shaping the extent and type of change that entrepreneurship creates.

In entrepreneurship research, the concept of institutions provides a broad macro-level explanation that accounts for different patterns of entrepreneurial activity. Institutions overarch individuals' characteristics and attributes (Kalantaridis & Fletcher, 2012). The socially constructed concept of institutions is a handy theoretical device that combines features such as laws and regulations as formal institutions, or socio-cognitive features such as cultures as informal institutions (North, 1990; Granovetter, 1992). Typically, economists are interested in formal institutions where the tangible impact of regulations can be measured. In contrast, sociologists (Scott, 2013) are concerned with softer influences on behavior. Although an abstract concept, it can portray the regulatory effects of context on individual actions. Indeed, the majority of contextual entrepreneurial trade-offs and opportunity costs (Acs *et al*., 2017) can be explained as institutional. Institutions are thus an explanatory variable of contexts. In effect, institutions circumscribe entrepreneurial agency.

Bjørnskov and Foss (2016) and Wennekers and Thurik (1999) propose that the institutional environment should be made explicit in entrepreneurship studies. Nonetheless, Bradley and Klein (2016), Bruton *et al.,* (2010), and Thornton, Ribeiro-Soriana, & Urbano, (2011), among others, conclude that institutions have proven especially helpful to understanding how entrepreneurial activity is shaped and how entrepreneurs make decisions. Overall, an institutional approach provides insights into the ways institutional factors, such as legislation and culture, relate to entrepreneurship (Acs, Audretsch, Braunerhjelm, & Carlsson, 2012; Audretsch & Keilbach, 2004; Wennekers & Thurik, 1999; Veciana & Urbano, 2008).

2.2. Institutions as enabling and constraining forces

Institutional scholars examine the influence of institutions and public agencies as an enabling and constraining force (Welter & Smallbone, 2011). Institutions can impact an industry and, in turn, entrepreneurial success (Baumol, Litan, & Schramm, 2009; Eesley, 2016). The key argument is that the institutional environment can influence barriers to entry and shape founding rates (e.g., Dobbin & Dowd, 1997; Sine & David, 2010; Sine, Haaveman, & Talbot, 2005). This literature shows how institutions and governmental policies that establish the rules of the game that regulate an industry, influence the performance of existing firms (Chang & Wu, 2014) as well as the penetration rate of new businesses (Hsu, Roberts, & Eesley, 2007). For example, Meek, Pacheco, & York, (2010) argue that when the U.S. government simplified the legal steps for launching solar ventures, and provided incentives, the founding rate of new firms increased. Similarly, when the U.S. government passed the Public Utility Regulatory

Policies Act of 1978, new independent energy firms could profitably sell electricity to the grid (Sine *et al.,* 2005).

In contrast, other scholars argue that institutional forces can negatively influence entrepreneurial activity within an industry and reduce its attractiveness (Zahra, 1996). These forces may exclude firms from selection, regardless of their economic performance (Chang & Wu, 2014), a mechanism the literature describes as institutional buffering (Aldrich, 1979, 1999). In addition, incumbent firms can consolidate their institutional position by building connections with established social and economic actors in the institutional environment (Baum & Oliver, 1991; Li & Zhang, 2007, Chang & Wu, 2014). Incumbent firms can take advantage of this institutional environment to strengthen their power, raise barriers and prevent new firms accessing the market (Yip, 1982). This industrial buffering in favor of incumbents is especially powerful in a highly regulated, capital-intensive and state-controlled industry. We recognize the need to pay attention to the specificities of the industrial context in which entrepreneurial opportunities are presented and how these play out in practice (De Massis, Kotlar, Wright, & Kellermanns, 2018). Yet, the extant literature rarely examines industry-specific factors, which are especially important in a highly regulated and technologically advanced industry (Chang & Wu, 2014).

In summary, institutional theory allows us to understand the institutional environmental factors that contextualize and affect entrepreneurship (Thornton *et al.*, 2011) and explores institutions as antecedents of entrepreneurial activity (Bruton *et al*., 2010). Institutional rules or policies may provide an environment conducive to entrepreneurship or hamper it by imposing barriers (Urbano *et al.*, 2019). Moreover, in a highly regulated industry institutional forces favor and foster incumbent firms and may even prevent new businesses from entering the market. Nonetheless, few studies have considered the impact of institutional forces on entrepreneurship at an industry level (Urbano *et al.*, 2019).

We believe the space sector provides an appropriate context to investigate the impact of the institutional environment on entrepreneurship. Indeed, the space industry is characterized by interventionist policies (Klein, 2012), high entry barriers, a very strict regulatory context and specific technological requirements (OECD, 2016; Pérez *et al*., 2017). The impact of the institutional environment in this context remains largely unexplored and offers a promising arena for investigation.

Our longitudinal data and analysis contribute to appreciation of the nature and power of institutions. We believe that an investigation of the dynamics between upstream and downstream actors will develop further understanding of how the institutional environment influences entrepreneurial activity across the space industry. Moreover, it can help explain how regulatory institutions combine with informal institutions to shape entrepreneurship.

Conceptually, we build from our analysis, adding to the literature by proposing a novel concept—*entrepreneurial space*. This concept extends the sporting metaphor of the rules of the game to show how institutions can determine the size of the playing field. The notion of an entrepreneurial space describes the arena in which entrepreneurship (Gartner, Stam, Thompson, & Verduyn, 2016) is played out. We find that institutions or policy rules in effect shrink the field. We discuss why entrepreneurship needs this space to operate, explain this in terms of an institutional structural component and discuss how it impairs entrepreneurial agency. We believe the concept has some explanatory power for other contexts.

For clarity, and to serve as a guide to this paper, we offer our empirically derived description of the concept. Entrepreneurial space has both abstract and material qualities. It is abstract in the sense that it only exists as gaps or voids between the structural barriers that configure institutions. When institutions are underdeveloped (Khanna & Palepu, 2000; Puffer, McCarty, & Boisot, 2010) or are in the process of being shaped (e.g., in an emerging field), the entrepreneurial space tends to be greater and more open. Entrepreneurial space is thus relative to these structures. Metaphorically, we might think of it as the crevices, cracks or crevasses where entrepreneuring can occur, but always relative to the institutions that organise the socio-economic landscape. Yet entrepreneurial space is material in that it can be quantifiable in terms of the extent of freedom to be entrepreneurial within the tangible dimensions of regulatory, economic, technological and social institutions. How much room is there for new ventures, innovation or entrepreneurial practices?

Although relatively stable, entrepreneurial space is ultimately fluid over time. Institutions alter as they adapt to shifts and change in the landscapes, or may be altered as entrepreneurs push out the boundaries of the entrepreneurial space. Such changes represent a dynamic for entrepreneurial agency.

3. METHOD

3.1. Research Design

We want to understand how entrepreneurship in the space industry is enabled and constrained by institutions, and what this implies for the freedom to be entrepreneurial. Our inductive, interpretative and qualitative approach aimed to broaden understanding of this industrial context and the impact its institutional environment has on entrepreneurial practices (Gephart, 2004). Institutional theory (North, 1994; Williamson, 2000) informed our approach and appreciation of previous work, although we noted the lack of industry-focused studies of the impact of the industrial institutional environments on entrepreneurship. Our qualitative approach generated a grounded understanding about how this industry, and interactions within and outside it, works with and against new business creation and entrepreneurship.

Our intellectual curiosity had been aroused by our initial case. How could such an innovative industry be so entrepreneurially barren? We decided to look at the industry as a whole, but conceptually were informed by the literature on institutions. Methodologically, we were concerned about the best way of collecting very diverse data, especially not knowing in advance what might be explanatory or even important. We chose the most open-ended data collection techniques and, from experience, decided to use inductive analysis. The constant comparative method (Anderson & Jack, 2015) enabled us to identify categorical themes and then to develop explanatory accounts. Although this worked well, it proved a very demanding and time-consuming trial and error method.

In-depth, multiple-case studies offered a sound, robust but open approach to investigating our research question (Alvesson & Sandberg, 2011; Gehman *et al*., 2018). Our multiple-case study brought together data and perspectives from upstream and downstream actors, major manufacturers, space innovative start-ups, small and medium enterprises, universities, space research centers, technology transfer officers and space business incubators. The views and reported experiences of various actors within the space industry ecosystem captured interactions between different contexts, well suited to addressing our research question and contributing to knowledge and understanding.

3.2. Case selection

Our respondents were individuals from different organizations, space start-ups, SMEs and organizations, all players within the space industry. We define a space start-up as "*a new business entity that provides space technologies, products or services, specifically one that manufactures satellites, launch vehicles, manufactures satellite ground equipment, provides services that rely on space systems and analytic services based on data collected extensively from space-based systems either alone or in combination with terrestrial systems*" (Bryce, 2018, p.1). When selecting respondents, we initially used purposeful sampling (Pratt, 2009). However, as the research progressed, we drew on snowball sampling (Martin & Eisenhardt, 2010).

Research began in a 10-year longitudinal study of a space start-up's creation and survival process (case C1) located in France from 2007 to 2017.[1] Initially, this start-up operated in the upstream industry. It offered a service for validating electronic components in simulated space flight. This validation service developed two products: a *flymate* and a *femtosatellite* for integration into a rocket. These were then sold to customers like research labs or universities. Gradually it moved downstream. At our final meeting, the entrepreneur explained how the firm now provides affordable services and fully featured worldwide data connectivity via nano-satellites (small satellites weighing 1–10 kg).

Through this start-up we became immersed in the industry and began to understand better its complexities and modes of operation. Our connection became very useful for meeting other local and industry players. Overall, this approach enabled a rounded and informed understanding of the industry. From the knowledge, experience and connections developed during this early process, we developed a list of key actors and institutions within the European space industry for further informed and purposeful sampling (Anderson & Jack, 2002).

3.3. Empirical Setting

The space industry operates globally, but also engages at a local regional level. In Europe, France has the most important European space ecosystems. In 2015, the European space industry turnover was €7.5 billion, €4.5 in France alone. The French industry mainly developed in the Occitanie region around Toulouse, the European space capital, and generates substantial local impact. For example, there are about 120 organizations in the Earth observation sector. Some 50 of these are service providers with 30 state-owned national entities and around 20 private companies. Moreover, 12,000 people are directly employed in the industry. Toulouse is home to half the French space labor pool and more than 25 percent of the

[1] The first author started this longitudinal case study during his PhD and continued to do so until 2017, when the entrepreneur abandoned cube-satellite activities.

European space industry workforce. The European space industry is complex and highly regulated. It is structured around national and European organizations, including the European Space Agency (ESA), the Centre National des Etudes Spatiales (CNES), and the European Organisation for the Exploitation of Meteorological Satellites (EUMTSAT).

To gain a comprehensive overview of the space ecosystem, in October 2015 we interviewed the manager of Aerospace Valley (AV) in Toulouse (case C2). This key informant was known for his knowledge of the industry and local engagement. Created in 2005, AV is the largest innovation aerospace cluster in Europe, with 869 members from both industry and academia, and owns a specialized incubator, the European Space Agency Business Incubation Centre. AV's mission is to promote and stimulate new space industry business creation. Our meeting identified 18 potential well informed respondents, including start-up founders, CEOs, space business angels, technology transfer managers, an incubator manager and influential individuals with significant responsibilities within large space companies and European and national space agencies. We carefully evaluated how well these potential respondents reflected key players in the industry. The co-authors discussed and debated, finally selecting 12 respondents, whom we then contacted. Two people from this list declined our invitation for confidentiality reasons. Interviews with the remaining 10 key actors in the space industry took place from October 15, 2016 to January 31, 2017. Based on the analysis of the first wave of interviews, we were able to identify five more important actors. We interviewed these additional actors during the period April 1–May 15, 2017. Following the analysis of these five interviews, we continued with a final round of three additional actors in January 2018. This gave us 18 cases plus case C1, making a total of 19 cases (Table 1).

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Respondents were interviewed in depth. Interviews were recorded, transcribed verbatim and then translated from French into English. Field notes, observations, and raw data were compiled. The rich and full output of this process was preliminarily categorized. Because of the novelty of our research subject and the scarcity of studies in this field, the respondents were very enthusiastic, generously sharing their personal experiences and views despite the confidentiality of their activities. They explained their experiences and situations, providing good quality data that enabled us to address our research question (Chenail, 2009; Pratt, 2009).

3.4. Data collection

The lead author was familiar with both aerospace and regional contexts. His personal network enabled access to sensitive data and locations, so primary data were collected from interviews, conversations and visits. We used the literature and our understanding of institutional theory to inform and develop our research question. We opted for open questions, using a flexible interview schedule to obtain respondents' insights and detailed descriptions of experiences, situations and practices. We triangulated data by using several data sources; this became important when we asked "Why did this happen?" Data collection was in two phases.

Phase1: 2007—17

We began with a longitudinal case study (case C1). We scheduled four face-to-face interviews per year during the first two years (2007–9). Interviews ranged from 73 to 121 minutes, averaging 90 minutes. In the third year (2010) we met the founder twice (125 minutes in total). Finally, we had one-hour Skype meetings each year from 2011 to 2017.

We used three different interview guides. The first was developed for the incubator advisor and manager and focused on the technological and economic specificities of the entrepreneurial project (C1) and the space industry, to learn about their characteristics and structure. The second was used for the initial interview with the entrepreneur. In this interview, we asked about his profile, team, story behind the project, business model of the future firm and technology used (femtosatellite). The third guide was put together for the third stage of follow-up interviews to monitor the evolution of the firm over time. It focused on the workability of the project, strategies adopted to deal with the institutional environment, its relationship with incumbent firms and European organizations and the evolution of entrepreneurial activities. Our process-based approach enabled an understanding of the chronology of events over the 10-year period.

Phase 2: 2015–17

The first case study (C1) provided us with a detailed overview of the space industry and offered a closer connection to its main players. To understand processes, we interviewed additional entrepreneurs, incumbent firms and key players in the industrial space ecosystem. With the help of the Aerospace Valley manager, we identified the 18 cases described earlier. Each respondent was identified as the actor in the most appropriate position in the organization to answer our questions (e.g., CEO, manager, VP innovation, founder, all with several years' experience in the space industry). However, in a few cases we were not satisfied with our meetings (incomplete answers, inability/unwillingness to respond, unclear/imprecise answers, missing information), so additional meetings were organized with other respondents from the same organization (co-founder, another manager, collaborator). In this second phase, we structured interviews around five major themes:

1) how agreements, contracts, procedures, rules and political structure shape the space industry;

2) how characteristics of the space industry impact entrepreneurship (political issues, role of the European Union and national governments, high capital investment, specialized knowledge requirements, core technology dependency, regulatory context, defense concerns, need to access expensive equipment, domination of incumbent firms, social perceptions of the space industry);

3) the nature and intensity of links between entrepreneurs and large firms and how they enable or hinder start-up creation and growth;
4) how entrepreneurs deal with barriers to entry to the market;
5) how larger companies collaborate with small firms and how the individuals interviewed deal with these issues.

Most interviews took place on the interviewees' business premises, allowing us to observe and record behavior and the environment at the same time (Charmaz, 2006; Yin, 1984). However, one interview was by Skype (C6). Two respondents (C15, C19) from the European Space Agency chose to be interviewed at our office. Visits to Airbus Space and Defense, Thales Alinea Space and CNES were closely monitored and controlled for security. Appointments were scheduled several months in advance to allow security services to investigate our identity and purpose.

Secondary data about our participants was collected through documentary sources. These included:

- strategic and annual reports of large firms (e.g., Airbus 2016–2017–2018 reports; Thales 2016–2017–2018 integrated reports) that gave an overview of the company's history, current and future activities, as well as its economic and financial performance;
- European Commission studies, strategic reports and programs (e.g., Horizon 2020, ESA Enabling & Support report, annual report 2016), all available online;
- videos demonstrating the technical feasibility of products, technical performances, the potential of new technology and characteristics of the new space economy, provided by the entrepreneurs or online;
- serial prototypes of the product, each with increasing technological sophistication;
- visits and observations in companies' labs;

- slideshows describing access to incubator services and facilities, pending technological validation and demonstrating the business model and economic viability of the new firm;
- business plans developed by the entrepreneurs that played an intermediary role with key actors and enabled the entrepreneur to access significant resources.

Our participation at the conference "Space industry: Between two eras," held in Toulouse in 2017, enriched our understanding of the industry. Representatives of key European space institutions attended this event and their observations, gathered informally, helped verify some emerging patterns in the data and pushed us to reflect on others.

In sum, our different sources of information—empirical interview data, the initial longitudinal case and meetings with key players—provided us with a full picture and grasp of the industry and space entrepreneurship. They also offered methodological plurality, supporting the triangulation process (van Burg, Cornelissen, Stam, & Jack, 2020). For confidentially reasons, the cases were anonymized. This helped us access rich data about sensitive issues related to their relationship with partners, colleagues and the political and industrial environments (Rasmussen, Mosey, & Wright, 2014).

3.5. Data analysis

As we collected data, we also analyzed it inductively (Corley & Gioia, 2004; Gehman *et al.*, 2018). The data provided narrative accounts of space entrepreneurship (Pentland, 1999) and descriptions of the space industry's policies, structures, rules, contexts, actors, dynamics and trends. The interview transcripts and other documents were read, compared, reread, shared and discussed, reflected on and discussed again among members of the research team.

First, we began the analysis by identifying initial concepts in the data and grouping them into categories (Strauss and Corbin, 1998). In this first-order stage of analysis we identified a high number of categories. We used the language used by our informants whenever feasible, or a simple descriptive phrase that reflected their comments credibly (Gioia, Corley, & Hamilton, 2013; Gioia, Langley, & Corley, 2018). As the research progressed, the views of different informants were brought together and compared. At this stage, we could see similarities and differences emerging in all the categories. Following the constant comparative approach (Bansal & Corley, 2012; Glaser & Strauss, 1967; Jack & Anderson, 2002), we moved forward with continuing iterations and reflection. This approach provided the basis for rigorous collection and analysis of qualitative data and assisted in determining the sampling and content foci for later data collection (Corley & Gioia, 2004). Data analysis quickly focused on the impact of the institutional environment on start-up creation and growth. From both the literature and our data, 20 categories emerged at this stage (see Figure 1). Data were examined and re-examined for details relating to these concepts.

Thereafter, we engaged in axial coding (Strauss & Corbin, 1998) and searched for connections between and among these categories. Through this process, we gathered the categories into seven higher-order themes. Bringing these together offered a way to explain respondents' situations (Bansal & Corley, 2012). These new themes helped us describe and explain how the institutional environment and policies worked to prevent or foster entrepreneurship in the innovative context of the space industry. At this second level, we focused on nascent concepts that appeared to lack adequate theoretical referents in the existing literature (e.g., policies produce a structure poorly conducive to entrepreneurship, policies strengthen incumbents' power to mold entrepreneurial activities, policies reinforce incumbent core technology dependency). This process took time, and much trial, error and reflection. This process of grounded research was critically informed by interactions between members of the research team, respondents and data relating to our interests (Suddaby, 2006). It formed a "recursive, process-oriented, analytic procedure" (Locke, 1996: 240) that continued until additional interviews failed to reveal new data relationships (Corley & Gioia, 2004). Finally, we ordered similar themes into three overarching "aggregate dimensions" that formed the basis of the emerging framework: entrepreneurial space, entrepreneurial freedom and barriers to enterprise. Our choice of analytic method was largely determined by previous successful experiences using the constant comparison method to relate contexts and entrepreneurial actions (Anderson & Lent, 2019; Anderson, Warren, & Bensemann, 2019; McKeever, Anderson, & Jack, 2014). Such studies produce voluminous unsorted raw data loosely connected to theory and, typically, a process view (Lamine, Jack, Fayolle, & Chabaud, 2015) is needed to see change. Our collective experiences indicated that the iterative to and froing, in what Anderson, Dodd, & Jack, (2010) called the dance of theory and data, produced useful theoretical concepts. This, again, was a laborious process of trial and error, sifting, sorting and selecting to find authentic and convincing categories and meaningful connections that help explain what happened (Jack, Moult, Anderson, & Dodd, 2010). The process opens the data in its natural context, yet ensures the analysis is firmly grounded in data, informed by appropriate theory. The final data structure is illustrated in Figure 1, which summarizes the themes on which our model of contextual exclusive pressures of entrepreneurship was built.

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3.6. Trustworthiness of the data

We took several steps to ensure the trustworthiness of our data. We organized the data (contacts, recordings, transcripts, translations from French to English, notes, additional documents) meticulously. The transcripts were reviewed by the respondents to ensure the accuracy of the content. Where interviews were conducted in French, we asked a bilingual translator, expert in the space industry, to ensure full content-faithfulness. Telephone and e-mail exchanges took place between the first author and the translator when there were doubts about the understanding of the content.

To gain an outsider perspective, we used peer debriefing, engaging other researchers in the space management field not involved in the study to discuss emerging patterns in the data. These researchers were invited to serve as a sounding board for our evolving findings and to pose critical questions about data collection and analytic procedures. The peers included department members, the space chair co-director of research and a highly experienced qualitative researcher. We used this critical peer reviewing to challenge and improve our approach.

4. FINDINGS

We set out to understand how entrepreneurship in the space industry is enabled and constrained by institutions, and what this implies for the freedom to be entrepreneurial. We offer a descriptive account of how the context operates, followed by an analysis of the institutions' impact on entrepreneurship. We use respondents' quotes to give voice to their experiences.

4.1. The structure of the space industry

Our data show considerable differences across the two segments (upstream and downstream) and companies in the space industry (see Figure 2).

--------------Insert FIGURE 2 here---------------

Upstream Segment

The upstream segment consists of manufacturers of space hardware and providers of technologies that launch systems into space. Typically, these are launch vehicles and services, ground control stations and space payloads (satellites, manned spacecraft, and space stations). The suppliers are prime companies and systems integrators who build on the contributions of subsystem and component suppliers. The upstream segment is a mature field and is highly regulated by political rules at both national and European levels. This segment is dominated by the European Space Agency (ESA), funded by 19 European states and has cooperative agreements with other states. Small and medium-sized enterprises account for three to eight percent of segment employment.

In Europe, space organizations are essential sources of initial funding for public R&D, as well as major anchor customers for space products and services. This market addresses European Union and commercial satellite operators' demand for spacecraft, launchers and satellites. Governmental demand is key for revenue generation and demonstrates a highly institutionalized demand context.

(C19) "*All observation systems go via the European Commission, which itself delegates purchasing contracts to the European Space Agency and which puts out European calls-for-tender and distributes activities… EUMTSAT, also via the ESA, procures weather monitoring, low earth orbit or geostationary systems.*"

(C15) "Most R&D in the space industry is financed by the agency CNES in France, ESA on a European level, and the DGA for military applications."

Downstream Segment

The downstream segment includes products and services delivered through the use of space assets. It includes activities related to space-infrastructure exploitation and provision of space-based products and services to end users. Space-based networks or earth observation data provide several opportunities to many other industries, from natural resource management to transportation, health, education, meteorology, disaster management and banking. For example, there are two parts to the satellite communications segment; first, fixed satellite services with TV broadcasting, internet backhaul and telecommunications backhaul; second, mobile satellite services such as marine, land and air, using satellite phones or small notebook-size broadband devices. This is an emerging segment, less structured and regulated than the upstream segment.

The European space landscape is dominated by two prime contractors: Airbus Defence and Space (ADS) and Thales Alenia Space (TAS). the German company *Orbitale Hochtechnologie Bremen* (HBO) is also influential, but on a smaller scale. These three large companies are responsible for the design and assembly of complete spacecraft systems, which are delivered to governmental or commercial users (e.g., telecommunications, earth observation satellites, launchers, human-rated capsules, satellite structures, propulsion subsystems). The primes collaborate with numerous SMEs at different levels of the space value chain of design and assembly of spacecraft systems or subsystems.

The upstream space segment is divided into four levels or tiers of actors who intervene in the different stages of the space value chain. These actors are very often subsidiaries of the primes and are scattered across Europe and beyond.

(C2) "*There are two large prime operators who share the activity between them—Airbus Defence and Space, and Thales Alenia Space. Around them gravitate many other actors of greater or lesser importance.*"

4.2. Space industry and entrepreneurship

Space-related activities in Europe are highly regulated. They are institutionally determined by European norms, policies and rules that, according to respondents, create significant barriers to entry to the sector and a restrictive climate that does little to encourage the creation or development of new companies. We identified two important policies influencing the sector: *(1) European industrial policy and geographical distribution;* and *(2) the rule of dual-use items.*

- ***European Industrial Policy and Geographical Distribution***

Industrial policy and geographical distribution play an important role in ESA procurement. The ESA's industrial policy comprises rules about geographical distribution, or geographical fair return (GFR). The ESA uses GFR policy, whereby a country's share in the weighted value of contracts must approximate its share of financial contributions. This policy encourages national contributions and promotes the distribution of space activities throughout its member countries (ESA, 2014).

In principle, the introduction of this rule should improve the competitiveness of start-ups and SMEs in a sector dominated by big companies. However, interviews with entrepreneurs and even managers within the primes show that this principle engenders a negative effect that considerably reduces the competitiveness of SMEs and reinforces the power of the primes. According to entrepreneur C2, one of the two major primes developed an integration strategy for all start-ups and SMEs in order to recover the money distributed by the agency. The unique legal status of European companies, defined by Community law and common to all states, allows this prime to exercise its activities in all member states of the European Union. The GFR principle impelled large companies to create a network of subsidiaries and partners in all countries and at different levels of the value chain of upstream segments to capture the maximum value created in this market.

(C8) "All modes of funding are possible with the 'fair return principle' rule, which is: each country that contributes to the ESA receives approximately as much as they give for the development of programs… As a consequence, Airbus bought everything that was out there, anything that moved that allowed them to recover money from the member states, because that's the principle of 'fair return.'"

(C19) "… Each subsidiary does the work in the state that finances the activity. A lot of companies that were independent before were bought by Airbus, which has a policy of having subsidiaries in every country where there are public space-related subsidies, in order to capture the fair return."

(C14) "Big companies like Thales and Airbus have a footprint in the big European countries with big budgets. Which means that they won't necessarily go towards SMEs… It's often been said that it wasn't very effective in terms of competitiveness for SMEs."

- ***The rule of dual-use items***

The European Commission considers products, technologies and space services to be dual-use items. According to the European Commission: "*Dual-use items are goods, software and technology that can be used for both civilian and military applications.*" The high-tech dual-use nature of space technologies, products, systems and services means that the space sector is highly controlled by the EU and governments. This controlled market has an impact on the competitiveness of companies and start-ups. It lengthens proof of concept and technological validation processes as well as time to market.

(C7) "In any case, the space industry is considered a dual industry, even in the legal sense. All our products and infrastructure are considered dual-use. There is no essential difference between civil and military technologies."

Essentially, this categorization raised formidable administration barriers. This was the case for the Supernova project (C1): the entrepreneur presented a prototype to customs, planning to send it to a foreign partner for technological validation. The entrepreneur reported that European companies refused to cooperate with him during this stage. The entrepreneur had to carry out numerous unforeseen and additional administrative procedures because customs deemed it a dual-use product. The complex administrative procedures for this kind of product take months to complete and may cause the creation process to fail.

(C1) "Our product carries the number E195 which is on a European list of dual-use goods and technologies… but we didn't realize this at the design stage… In our case, we don't wait for export clearance from the Ministry of Defence, which takes a long time. If that were the case it would be better to shut up shop and leave (...). To get clearance takes months."

(C1) "I've met people experienced in this field…, and I assure you there were people crying… a person with tears in her eyes because she was so upset, because she didn't think there was so much paperwork and it caused her project to be aborted."

4.3. A competitive structure that discourages entrepreneurship

European space policies have led to the development of a competitive structure in the space market, which is dominated by two French companies, Airbus and Thales, each with around 25 percent of the global market. This positioning is reinforced by the effects of the principle of GFR.

In practice, to deal with international competition and employ the GRF rule strategically, Airbus and Thales, known as "the French team", have put in place a "coopetition" strategy. Responding to calls for tenders, the two primes often set up shared consortiums. Given financial returns by country and the scale of the challenges and project contracts, European rules oblige the primes to collaborate in a relationship of coopetition, the long-term strategic results of which will be beneficial for them both.

(C16) "We work together. We are forced to have a lot of interaction, even if we each try to preserve our own technologies and skills. We've often worked together for the telecommunication satellites in Middle Eastern countries. For Arabsat, for example, we put forward shared offers. We can be competitors, we can be partners, it depends on the context, the situation, the competition. Often, it's in our interest to work together in relation to our American competitors. ... In any case, whoever wins, for reasons relating to geographical returns, they have to talk to the other."

(C14) "... So, it's a fierce competition. You have projects like Meteosat geostationary that we won, and then Airbus won Meteosat polar orbit. They are huge contracts. The stakes are incredibly high… And afterwards, according to the consortium that won, the geographical return to different countries is carried out under the prime structure if it's Thales or Airbus, or towards partners."

Nevertheless, this competitive structure within a narrow market increases the market power of primes and reduces opportunities for new arrivals. This limits the area in which they can operate, shrinking their chances of success and discouraging entrepreneurs from entering the sector.

(C17) "*For me, a start-up in the space sector is the holy grail. It's everyone's dream and fantasy. But, for a small company, getting the chance to work with Airbus is extremely difficult…"*

(C4) "Because of these rules, there are no large companies…. All attempts to have a large company have been stopped and squeezed out by Airbus. In telecoms and observation, there are practically none, there's no way for smaller ones to grow."

As a consequence of these European and national political rules, the power of the primes drastically limits start-ups' freedom in an ecosystem locked down by codes and specific norms:

(C1) *"The space industry is very particular… there are house rules… it's very unusual."*

(C8) "*What we are looking for is not in a very fragile environment, ruled by a gorilla, the king of the jungle, not even in the shadow of the gorilla, but below the whole ecosystem."*

Indeed, in terms of their relationships with the big companies, small firms are forced to obey the rules imposed by primes and derived from European political institutions, which, according to entrepreneur C10, will not hesitate either to crush them or to buy them out if they have developed a viable technology that is of interest to them. There are no other outcomes:

"*They can kill us at any moment… they might call all the clients. It's illegal. But even if it's illegal, we can't take them to court, we'll lose. We'll be sunk. When I left Airbus to set up my own company, a number of people said to me: Go ahead, in any case, if you're successful you'll be bought and that's the end of it.*"

Within this institutional environment it is virtually impossible for start-ups to grow. The primes may offer them contracts that allow them to survive but never enough room to develop.

(C15) "Upstream from the space industry, conditions are quite difficult because the entrance fee is very high. You find parts manufacturers, suppliers of propulsion systems and electronics, there are many of them. The big ones are there to stop them growing. Because they want to get all the added value. That's for sure. Then, they crush them. How? They force them to keep lowering their prices and keep them in constant competition and after a while, the head of the company will just stop."

The primes are thus an obligatory point of passage in the space value chain, gatekeepers of the space. In an attempt to avoid or escape this domination, entrepreneurs go outside in order to develop the application of space technologies.

(C2) "*For parts manufacturers (upstream) the primes are an obligatory check point.*"

In contrast to the upstream segment, we found that it is much easier for an entrepreneur to create and develop a start-up downstream, applying space technologies. This application is in effect spillover from the upstream, but is also a strategic response to institutionalized control. This segment, less politically regulated than the upstream, offers more freedom for enterprising. There is a chain of non-space actors who use satellites to sell space-related services, for example, Google Earth—satellite operators who use satellite images to sell by-products. According to interviewee C2, every Euro spent on spatial infrastructure creates economic activity elsewhere. Examples include the agricultural industry, forecasting, coverage, monitoring of fishing boats, birds, sea levels and maritime anti-collision radar systems.

Indeed, the different technologies developed upstream constitute a wealth of opportunities but these will only be engaged outside the space sector.

(C17) "It is possible to create start-ups which offer intelligent services using Earth observation images to map aquatic and coastal environments, offer services to farmers, carry out services for the forestry departments, etc. So, using satellite images and creating start-ups based around ways of using spatial applications."

(C19) "The rules are less rigid in the application segment which provides us with more possibilities. There are swarms of companies in the application field. Hundreds in France that are doing pretty well."

4.4. Technological context and European standards

The physical environment in which space products operate is technologically hostile because of the extreme conditions of space. Requirements include: resistance to both high and low temperatures, extreme long-term reliability, high vibration capability and extremely low defect levels. Respondents explained how European institutions have put in place long, complex and costly qualification processes that lengthen the time to market for products and technologies.

Given the enormous sums needed for qualification processes, primes and their partners have financial support from European institutions. Primes act for the institutions as they control, check and evaluate. This increases the interdependence of European institutional actors and the primes. This relationship is characterized by a very high level of reciprocal trust. This kind of trusting relationship requires years of collaboration and evaluation to become established and to allow a partner to demonstrate its ability while adhering to prescribed standards.

(C16) "We have this constraint of spatial qualification which takes a great deal of time… There are lifespan tests that last a long time. If they say that they want something to last 15 years, they won't carry out tests for 15 years, but it can require several years of testing, in extreme thermal environments, radiation tests… This requires a level of testing that is just not available to small companies."

(C14) "[This] process requires the financial support of our sponsors who are space agencies or the European Union… They are very demanding on the quality of our systems and products…. Clients are very intrusive to make sure that we have qualified properly."

Qualification rules and standards for technologies create additional barriers for new entrants, particularly start-ups, amplifying the impact of policies. Many young entrepreneurs working in the space industry have great ideas but have neither the means, the broad range of technical skills required nor the acquired legitimacy to ensure qualification of the product.

(C15) "A start-up, for example, if they go to see a banker and say, 'I'm going to develop technology, but it will only be used in 10 years… because qualification in the space industry takes that amount of time'… the banker will simply refuse."

Interviewee C16 explained how space products are a concentration of cutting-edge technologies and very complex systems that are the fruit of a synergistic combination of disciplines, such as mechatronics, mathematics, optics, electro-magnetism and signaling.

(C16) "The space industry requires a rather large technological base. There are many technologies inside our satellites. These are really complex systems. We need a lot of mechanical, electronic, electrical, propulsion and signaling technologies. A telecoms satellite that weighs six tonnes contains many sorts of technology inside."

We found that this technological complexity exclusively benefits the primes. It intensifies the effect of political measures making it very difficult, or even impossible, for new entrants to work with one of the primes or their subsidiaries. Thus far, we have demonstrated how institutional structures, policies and processes work against new firms. There are also cultural institutional impediments. We found that, despite its reputation as an extremely innovative sector, the space industry is very conservative. The actors only change technologies if the client directs the change. This can be explained by the complexity and high costs associated with developing new technologies, as well as the constraints relating to the process of qualification. This conservatism inhibits the type of open and radical innovation that might potentially re-invigorate the industry, and instead favors a closed, incremental process of innovation.

(C9) "There is a little bit of conservatism that means that people think they have the best solutions internally and so, they're not open. I realize that there is a culture of conservatism that is still very dominant. We change products or technologies when the market demands…

It's always a question of giving up the comfort of using a product that's already qualified and with which we'll have no development issues."

Consequently, technological specificities of the space sector and the culture of conservatism in the established companies have favored incremental innovation based on existing technology and, of course, established players. To succeed in the industry, you need to have experience in the field and already know the actors well. This forces collaboration with the primes or their European subsidiaries on their terms because they have total dominance over all space technology.

(C14) "…There is a lot of technology in a satellite. So, we will look for incremental improvements. I was talking about the example of solar panels… Little by little, we are augmenting the output of these solar cells to get more and more available energy from them whilst keeping their surface area limited."

(C5) "It's often an innovation of continuity. Because that's linked to security—they are not going to change the whole architecture of flight controls just like that. It's still innovation, but step by step."

The director of the Toulouse TTO (C17) gave us an example of a research team from the ISAE-SUPAERO[2] working on human interface technologies—machines for the cockpits of the future. This team worked with Airbus on a collaborative research project that had developed new technology. The researchers wanted to create a company to exploit the ideas but needed access to old patents owned by Airbus. Airbus responded: "*Now you're touching on a strategic issue… If you want, we can buy your license, but you won't be allowed to go into aerospatial. And what's more, we have other programs in parallel and I think we're more advanced than you. But those are top-secret."* Airbus had consolidated its prime position at the expense of the small company. The new company did not get off the ground.

Moreover, to be able to work with one of the primes, a company must have a shared history of technological validation. Given this constraint in a narrow market— "*I think the size of the market can be an obstacle*" (C6)—it is therefore very rare to find new SMEs that can

[2] A world-leading higher education institute in aerospace engineering.

penetrate and cement strong relations with the big companies. Indeed, the majority of SMEs are subsidiaries of the primes, as interviewee C15 confirmed:

(C15) "The obligatory entrance requirement to becoming a supplier on satellites is to get in with the purchasers via a shared history of technological validation and procurement of trust… It's a market where the parts manufacturers are often themselves subsidiaries of groups, or when they were SMEs, they were bought by the bigger actors. In the end, there are very few SMEs or VSEs that play a role as sub-contractors. No, it's a small world."

We also found governmental dominance of the space industry prioritized a scientific logic of advancing knowledge and technological performance without much attention to profitability.

(C19) "Now, the person who invents a technological solution still has no certainty about the market. Nonetheless, they are encouraged to progress with development. If this allows scientific missions to be carried out, perhaps the agencies will agree to finance their development. But at that point, they finance the development to allow the missions to use it in the future, but not for the economic viability of this invention".

According to one entrepreneur (C8), seeking profitability and a return on investment are not priorities for the primes. Their first objective is to push forward technological knowledge, to dominate the industry and fill the technological space. This is more important than economic cost-effectiveness.

According to entrepreneur C8, "*a large group is not necessarily going to look for profitability. They will just occupy territory. As a former employee, I often saw this at Airbus. They will go ahead and innovate, but the business model… they couldn't care less… even if they have to reduce the price by 90%... it doesn't matter… They just have to occupy the territory.*"

Interviews with the managers of the TTO at the University of Toulouse, and the managing director of the TT at CNES, confirmed this perception. To date, no new company has been created via the research value mechanism, despite the presence of several world-renowned research centers, universities and institutes in the space field in the Toulouse region. The managers reported dysfunction within the triad of university-industry-policy. Public authorities provide funding for space research, university laboratories produce interesting results, but the transfer of these results to the space industry remains almost non-existent. The TTO's managers of the University of Toulouse told us about their four technological areas (Biotech & health, AI, Energy & systems and Space). The only area without any technology transfer activity is space. This is attributed to how the space industry operates.

(C17) *"In the space industry, I really don't think we have a lot [of entrepreneurship]. Today, to give you an idea of numbers, since I've been here, I've dealt with perhaps 100 opportunities. I don't have a single example for the space industry… Our sourcing for the space field is very limited because it's CNES who are on that. They only send us dossiers when they think that there's a need to look beyond the field…. When you are working on a spatial technology, i.e., destined to be used on a part, or satellite or something, honestly, it's out of reach… The cycle is too long, it's too much."*

These accounts explain how barriers are formed by features such as the length of the qualification period and the strict requirements of evidence of financial and technological capacity. Our data showed that it is extremely difficult for an independent start-up to secure long-term funding for uncertain returns. The length of the creation process for new products and the narrowness of the market mean that investors are simply not interested. Taken together with the absence of an established relationship and the trust that engenders, the barriers become formidable.

(C16) "The specificity of the space industry means a specific environment. The smallest test in a space environment requires serious means, the means to test radiation, exposure to space, the sun's thermal heat—these things require enormous resources in terms of testing."

(C15) "There is no money. I work in the business angels' section here, we will never give money to guys to make a satellite if they have never done it before. So, it's a funding problem to gain access. Yes, and then the narrowness of the market due to fragmentation along national political lines. Investment funds are not interested in the space sector."

(C17) "… Funding is an important part and can be a big obstacle."

We conclude that the resources available to enterprising ventures are poorly suited to the upstream sector.

4.5. Cultural and social institutions

According to Supernova's founder (C1), people think the space field is unattainable. All the received ideas, clichés in the media, in people's minds, create huge barriers for him: "… *It's this prejudice that today poses us a big problem in relation to our interlocuters and prevents us from making progress. When someone like us wants to enter the field with the skills and means at our disposal, we are looked down on and not taken seriously. In our company, the space field is often seen as an industry reserved for the big companies—NASA, ESA, EADS (ex. Airbus—and there's no place for innovative SMEs. These barriers force us to spend an enormous amount of time and energy trying to convince people that what we're doing is based on real opportunities and real skills that we have…."*

Moreover, the vice president for innovation of one of the two primes (C14) commented: "*Perhaps it is cultural or a lack of understanding or use of applications in our fields of activity and things that people have seen or heard.*"

Another cultural obstacle to entrepreneurship is the primes' attitudes to risk. Many respondents told us that given the expense of launching a rocket or satellite, the primes do not want to risk new start-ups with no history or guarantee of longevity. If a firm has an innovative technology that could be integrated into a system, they must go via the prime, which will oblige them to cede their license to it or even to a competitor. So, it is almost impossible for a young start-up to work directly and survive in the space sector.

(C17) "The first rule when you're an industrial player on the scale of Airbus, is to say to yourself, 'I'm setting up equipment, I need several sources.' If there's any chance of the smallest hitch and my subcontractor isn't able to manufacture, my whole chain of production will stop. It's unthinkable. So, the first question to ask a new start-up is: 'Do you have a license or a patent? If you want to work with us, you will have to give your license to someone else, to your competitor, because we need someone who is able to do it as well as you… You cannot have the monopoly. If you have the monopoly, we're not taking it.' Even if it's really great, it's far too risky… I have examples of that, but I can't name them because it would not go down well."

This aspect of the internal culture of the primes precludes entrepreneurship. Two entrepreneurs, former Airbus employees, explained there is resistance or even hostile behavior toward start-ups. This was notably visible at the intermediate level, where start-ups are seen as a threat, working in direct competition to the company's own services. As Garud, Hardy, & Maguire, (2007, p. 690) explain, "What may appear to be new and valuable to one social group may seem threatening to another." In practice, they sabotage start-ups to internalize activity that is supposed to be carried out by the entrepreneur. Entrepreneur (C8) told us: "*It's not easy for employees of large groups to accept that a start-up with a few people has had an idea that they didn't have, or that those people knew how to manage the development of a stage which the group did not see as possible, but that turned out to be a good idea. There is that kind of barrier to overcome.*"

For personal interests, the middle-ranking hierarchy may block collaboration projects between the primes and start-ups, leading to a closed innovation process. The entrepreneurs also believed that supportive actions for space entrepreneurship from the upper echelons of the prime hierarchy are nothing more than PR to satisfy the expectations of public authorities.

(C19) "The reaction of the big groups with regard to SMEs varies according to the hierarchical level. There are higher echelons of the big groups that think it has to be done to please the ministers… There are heads of service who see the arrival of start-ups as competition. And the lower you go in the hierarchy, the more people like to see R&D carried out within their own big structure."

(C19) "At Airbus, there's a huge hierarchy. There have been engineers and lower managers who have made complaints to the internal Ethics and Compliance department, saying that [entrepreneurs] didn't have the right to do what they were doing and who called our clients to say, you do not have the right to work on what they're doing."

(C8) "I experienced a meeting with someone very high up in Airbus…, who asked someone in his team to take action to evaluate us. This was never carried out. That person did not obey orders and admitted to someone I knew that it was out of the question to make us work, that he would do everything to slow us down. It was to protect his little department. He said, 'Perhaps we'll have a budget to be able to do it ourselves.'"

4.6. Closed space actors' network

We found that policies, and European rules in particular, have led to the development of a specific space actors' network. It is a tight circuit where social links are strong but closed to outsiders. The center is occupied by the two primes, around which many small actors gravitate. We see this as a strategic network enabling the primes to determine membership. Exclusion is likely to be fatal to SMEs because the primes can stop contracts or allow relationships to deteriorate if this suits their purpose. Rather than a collaborative and innovative network (Hardwick, Anderson, & Cruickshank, 2013), it seems to function almost coercively to control. Moreover, the GFR principle reinforces the primes' network centrality and power.

Nonetheless, we were surprised at the extent to which relationships overlapped—everyone knows everyone else. We came across the same examples and anecdotes in almost all interviews. We also noted a social dimension; several clubs and associations formed a social forum for the actors (e.g., the Galaxy Club in Toulouse). Alongside the overlapping relationships, the same people are members of these clubs. To join this very closed circle, you need to know one or several members even to be recommended for inclusion. Without previous connections and strong links, it's impossible to join. Where we might expect the socializing to foster new relationships (Jack *et al.*, 2005), in this case it works as an exclusionary device.

(C17) "It's interesting to see that in the Toulouse region, there is a network of 50 to 60 members of companies who work in the space sector and meet up. It's a network and its members are quite well known. Perhaps a little too much. You find the same companies in the meetings of Aerospace Valley stations, the Galaxy Club, etc. Honestly, you need to know one of the members … you have to be authorized to be a member in this context…."

(C19) "If you are a start-up… who nobody knows, that's going to be a bit complicated. Because since everyone knows one another, they avoid bringing in someone who is actually outside of the picture or whatever."

(C15) "Success in the space industry requires belonging to a network."

However, the development of the "new space economy" has alerted public authorities to the urgent need to support entrepreneurs and to make a place for new start-ups. In France, for example, this willingness can be seen in collaborations between actors in the space sector and competitiveness hubs. As C18 said: "*There is a real willingness at state level that I've seen* *evolve over the past five years."* In the past two years this partnership has led to a rise in boosters for space entrepreneurship. In Europe, for example, we observed the creation of the ESA business incubation centers. However, to date, these initiatives have been unable to overcome the barriers we report.

5. DISCUSSION

Our decade-long immersion in the space context allowed us to understand not only the complexity of the space industry but also the institutionalized power of the prime players within it. By taking an institutional perspective our study shows that despite its very innovative character, the space industry remains unfavorable to entrepreneurship. The institutionalization of interacting political, regulatory, technological, financial, and even social features limits the creation and growth of start-ups. This pushes entrepreneurship out of the space industry.

Our fine-grained analysis of the formal and informal institutional environment contributes to the understanding of the ways policies can create institutional pressures and an industrial context that deters innovative entrepreneurship. The institutional framework has a profoundly negative effect on start-ups and growth (Fini *et al.,* 2017). Formal institutional factors in the space industry discourage entrepreneurial initiatives and stymie the growth of small firms. This institutional context favors the established firms (Aldrich & Fiol, 1994) that dominate the sector, challenging entrepreneurship. The culture of informal institutions works to reinforce the exclusion of enterprise. The actors that occupy the space industry and society appear convinced that it is the exclusive domain of big firms and institutes. Small firms, regardless of innovation, lack legitimacy. Moreover, we note how middle managers strategically exploit their position to usurp smaller firm initiatives. Our contextualized study extends the conceptual links between institutions, strategy and entrepreneurial practices.

Our findings show that while entrepreneurship does not thrive within the space context, it is a wonderful launchpad from which entrepreneurship can take off. The competitive structure and regulatory pressures thwart entrepreneurship but create an innovation factory, albeit one without a production line. Instead, the industry provides a platform for entrepreneurship. Hence, we conclude that while there is little space for entrepreneurship upstream, the sector enables downstream entrepreneurial space. There is a wealth of entrepreneurial opportunities in the application segment through the transfer of spatial solutions to other industries. This has enabled the emergence of an ambitious and burgeoning entrepreneurial application sector. Aerospace technologies, like satellite imagery, enable application fields (Terjesen, 2016) as varied as agriculture, transportation and smart city planning. New digital infrastructures, such as nanotech, robotics, artificial intelligence, cloud computing and astro mining, draw space actors into a new space economy. The entrepreneurial intermixing of new technologies has redrawn industrial boundaries. Indeed, this new space economy has created a new context with very different institutions.

5.1. The Entrepreneurial Space

We now consider the theoretical implications of our findings. Our case is extreme, largely because of the strength of the institutions and public policies, but extreme cases are useful for theory. Our work confirms what we already know about the power of institutions to shape sectors. In this extreme case we found that institutions effectively shut out entrepreneurship despite formidable pressure to be innovative at this leading technological edge. We want to use this case to add to our conceptual institutional toolkit by proposing a novel concept, *entrepreneurial space*. By space, we mean the room *for entrepreneuring* (Gartner *et al.,* 2016). We build from the argument that institutions shape enterprise by building or lowering barriers to practice; we argue that strong institutions can also determine the scope for enterprise. We envisage this scope as the arena for enterprise, forming the space where entrepreneurship has the freedom to operate. We saw how institutions minimized the entrepreneurial field—the entrepreneurial space (Anderson *et al.,* 2002; Beckert, 1999; Garud, Hardy, & Maguire, 2007; North, 2018)—and how they limited the freedom to be entrepreneurial. Our analysis demonstrated how this entrepreneurial space was pegged out by institutions. We saw how it confined small firms that conformed, how it was delimited to compliant firms and, importantly, how little room they had to maneuver and enact entrepreneurship. Our analysis revealed how the social and technological context has intensified the effect of the rules of the game to limit entrepreneurial freedom and downsize entrepreneurial space.

Institutional theorists use sporting analogies to describe the rules of the game and players as the agents of change (North, 2018; Williamson, 2000). Following the sporting analogy, we believe that institutions determine the nature and size of the playing field—the entrepreneurial space. When institutional regulation is high, the playing field is too small to allow entrepreneurs to make connections (Anderson, Drakopoulou Dodd, & Jack, 2012) across the entrepreneurial space. This means that entrepreneurial agency is diminished because freedom to move around playing an entrepreneurial game in this field is very limited. We saw how downstream the field dramatically expands the entrepreneurial space to allow new connections. That is to say, there are opportunities to make the connections that characterize and enact the practice of entrepreneurship. Thus, entrepreneurial space is a structural feature of institutions.

From a process perspective, we can consider the role of agency in inventions, innovation and entrepreneurship. Conceptually, in Schumpeterian and Kirznerian analysis, the entrepreneur is endowed with agency to convert inventions to innovations, or to recognize and implement opportunity. Our analysis shows that agency—the capability to make things happen and bring about change—is bounded by institutions. As Beckert (1999) puts it, institutions are a precondition of strategic agency. While we are well aware of the problem of embedded agency, the question arises of how to change an institution when you are part of it? Yet, the issue here is not embedded agency, but the limitations imposed on agency by institutions. The actors in upstream aerospace do not have the entrepreneurial freedom needed to convert inventions to innovations. Opportunity, even if it is recognized, remains only an opportunity that cannot be implemented. This constrained autonomy and inhibited agency results from a confined entrepreneurial space. Entrepreneurial agency needs an entrepreneurial space in which to develop.

We believe there is theoretical utility in this concept of entrepreneurial space. For example, it explains the absence of entrepreneurship from command economies such as the old Soviet Union. If we apply the concept to understanding informal entrepreneurship in emerging economies, we can see a large entrepreneurial space, but one sparsely populated with opportunities. Similarly, China's transition can be seen as opening up the space for entrepreneurship. Indeed, we can even discern the current pyramid-like shape of China's entrepreneurial space. The broad base has room for a mass of many small and modestly innovative businesses. As we ascend, the pressure of institutional regimes constricts the space to conforming firms. At the top there is only room for entrepreneurship that matches and enables the institution.

This idea of entrepreneurial space seems to capture the dynamics of entrepreneurial agency and institutional structuring. It senses the tensions of change and control, stability and change—even change and continuity. It gives us a metaphor to appreciate how the change-making power of entrepreneurship and innovating is institutionally bridled and reined in to shape this entrepreneurial space. Notions of open wide prairies where entrepreneurship roams freely to engage with any and many opportunities to change, improve and develop become fenced, corralled and smaller.

In essence, entrepreneurial space describes the outcome of the effects of institutions on entrepreneurship. We applied it here within a specific industrial sector to help explain the relationship between innovation and entrepreneurship. Yet it seems conceptually versatile with some explanatory power in other units of analysis. We saw how it could plot, map and delineate entrepreneurial geographies. But it may also have utility in other entrepreneurial contexts, such as women's enterprise or migrant entrepreneurship.

5.2. Implications for policy

In terms of the implications of this study for policy, we see that while institutions matter for entrepreneurial outcomes they also matter for political outcomes, which also affect entrepreneurship. From our study, we note the strong links between industry-industry and industry-policy but few strong links between the space industry and universities. We also note an asymmetry of information and a delay in understanding between universities and research centers with space companies. We see a real need for policymakers to work to strengthen these links. This could be achieved by policymakers creating a space and working at the regional level to bring universities, industry and policymakers together to learn from each other, share ideas and transfer knowledge. Such spaces would strengthen political institutions and help policymakers make more informed decisions that are better suited to the particular entrepreneurship space at the industry and regional level. Taking the lead in this way would also work to enhance the triple helix—university-industry-policy—relationship (Etzkowitz & Leydesdorff, 2000), which is less evident and needs to be addressed. Based on our data, it appears that the triple helix has not adapted to the specificities of the space industry and has been incorrectly implemented in the European context. One way to stimulate the commercialization of scientific research results and to make this tripartite relationship effective would be to develop research partnership programs, bringing together large companies (e.g., Airbus, Thales), researchers and public research laboratories. In parallel, policymakers could implement policies to attract international venture capital to help finance start-ups and also transform and reinvigorate the upstream sector. We propose that this tighter matrix could operate within the entrepreneurial space. By starting out within the space, barriers would not appear; innovation would already be legitimate, albeit likely to be institutionally ensnared. Far from perfect, because of institutional power, such arrangements could nevertheless push out entrepreneurial space to allow innovation in.

Policymakers also have a role to play in what they deliver in terms of incubation support and nurturing space entrepreneurs. We were struck by the lack of incubation mechanisms developed specifically for the space entrepreneur. Where these were available, they seemed to take a short-term perspective, overlooking the time-to-market factor in this context. A more realistic and informed approach by policymakers that appreciated what happened on the ground would help here. Specific incubation mechanisms or accelerator support (Amezcua, Grimes, Bradley, & Wiklund, 2013; Kolympiris and Klein, 2017; Mian, Lamine, & Fayolle, 2016) designed by policymakers and geared toward the space entrepreneur could prove extremely beneficial for all those involved. However, this would mean policymakers and their institutions taking a longer-term perspective. They would also need to appreciate that when it comes to the design of incubation support, one size does not fit all (Lamine *et al.,* 2018).

Moreover, taking a broader view, the European Space Agency plays the same role as NASA (USA), JAXA (Japan), CSA (Canada) and Roscomos in Russia. In the upstream segment, governments play significant and key roles. They provide funding at a very high level and set up international and national partnerships. For example, the International Space Station (ISS) is an international collaborative platform, a partnership between all these different agencies. At the national level, in the USA, a public-private partnership (PPP) has been concluded between NASA and SpaceX, an entrepreneurial firm founded by Elon Musk. Such PPPs boost public investment programs in research and space exploration. The upstream space segment has recently been opened to the private sector, as SpaceX and the recent JAXA partnerships demonstrate. Europe could foster and actively support a similar type of PPP arrangement, via, for instance, a targeted call for tenders. This could be an effective way for public policy to open up this industry further and also a way to increase competitiveness and expand the entrepreneurial space in this industry.

5.3. Opportunities for future research

This work also suggests opportunities for future research. We have explored one industry and how entrepreneurial space works in one context. It would be interesting to extend this research by looking at how things work in other contexts, such as the USA, Canada, Russia, India and China. We suspect things will differ considerably between western economies and emerging countries and/or those economies in transition. Moreover, institutions may operate differently. This will help address calls for the need for more work that takes account of the context in which entrepreneurship takes place (Jack & Anderson, 2002; McKeever, Jack, & Anderson, 2015). The concept of entrepreneurial space is a handy tool for investigating contexts. It may even be possible to develop ways to measure the entrepreneurial space and so provide objective accounting, mapping realistic entrepreneurial possibilities across a variety of contexts.

Future research could also be designed to explore different forms of PPP in Europe, the USA and Japan to see to what extent they could become drivers for opening up the space industry and boosting space entrepreneurship. It would also be interesting to compare different national space agencies, such as NASA, JAXA, CSA and Roscomos, and examine how they operate and how they are shaped and influenced by their political and cultural institutions. A longitudinal study of a PPP could provide information about the mechanisms of network construction and the consequences of the performance of such a partnership. Examining how the triple helix model works in different ecosystems (USA, EU, Japan, etc.), and how efficiently, could offer complementary insights.

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TABLE 1 Description of sample firms and case data

Characteristic	C1	C2	C3	C4	C5
Founded in	2009	2005	1961	2015	2007
Brief description	**Start-up 1** Initial concept: Design, launch and exploit femtosatellite communicators in orbit. Current activity: provide affordable services and fully featured worldwide data connectivity via nano-satellites	Most significant innovation cluster in France in fields of aeronautics, space and embedded systems. With 124,000 industrial employees, represents approx. 1/3 of workforce and 8,500 researchers representing 45% of French national R&D potential in aerospace sector.	Centre National des Etudes Spatiales (CNES): French space agency, a government organization. Responsible for shaping and implementing France's space. CNES is a major source of proposals for maintaining and developing French and European competitiveness and ensuring they remain key players in the space domain.	Global aerospace business accelerator where start-ups and Airbus intrapreneurs speed up transformation of innovative ideas into valuable businesses. Accelerator has developed a "hybrid" concept to collaborate closely with start-ups while allowing smaller organizations to understand better needs and ways of working of large groups. 4 campuses across the word.	**Start-up 2** Company is specialized in fields of mechanisms, propulsion, scientific equipment and optomechanical systems designed for space industry.
Principal informants	- Founder & CEO (2007–2017) - 2 interviews with incubator manager - 2 interviews with the business adviser - 1 interview with the co-founder	-Manager -Responsible for space unit	-Director of Technology Transfer Office	-Director -2 incubatees	-Founder & CEO 22 years' experience in spatial qualification activities
Secondary data	-Visit to the research lab -Participation in assessment meetings within the incubator -Participation in the team meeting and prototyping test -Visit to the science park - Internal reports - Videos of the experiments - Different versions of prototypes	-Power point presentation -Website -Internal reports	-Website -Internal reports	-Internal reports -PPT presentation -Visit to the accelerator's facilities	-Website -External reports
Upstream and/or downstream	Downstream at start-up creation Upstream 7 years after	Upstream and downstream	Upstream and downstream	Upstream and downstream	80% upstream and other activities in automotive industry
Nature of innovation	*Femtosatellite* (satellites with a mass less than 100 grams)			All technologies applicable to the aerospace industry	e.g. development of space mechanisms for activators' mobile part in a satellite. Astronauts' equipment

Size		869 members from both industry and academia.	280 employees	24 start-ups each year	200 employees
Length of interview	22:30:00	1:00:23	1:14:39	1:10:43	1:10:02

Characteristics	C6	C7	C8	C9	C10
Founded in	2012	2015	2013	2012	2011
Brief description	**Start-up 3** Equipment development for telecommunication satellites	**Start-up 4** Provides solutions based on location and navigation systems	**Start-up 5** Specializes in software and sells data recovery solutions to aerospace companies	**Start-up 6** Offering innovative electronic switching solutions shrinking size, reducing power consumption and improving electrical performances of circuits	**Start-up 7** Founded by experts in aerospace industry. Leading provider of end-to-end, visual intelligence solutions that enable enterprises to capture, manage, analyze and turn collected satellite images and data into valuable business insights
Informants	CEO and founder	Founder and CEO Subcontractor European Space Agency—15 years' experience in space industry	Founder & CEO 25 years' experience in space sector	President, founder and CEO	Founder and CEO
Secondary data	Website	Videos simulations Website	Aerospace specialized press	Website PPT presentation Internal reports	Reports Visits to labs and manufacturing site Drone prototypes
Upstream and/or downstream	Upstream	Upstream and downstream	Downstream	Upstream	Downstream
Nature of innovation	New technologies for telecommunication satellites offering new category of antennas	Global Navigation Satellite System (GNSS) simulation & receivers' market	Real time engine monitoring	Micro electromechanical systems technology component of satellites. An innovative switching solution exhibiting higher performances than conventional technologies.	Visual intelligence applicable to a variety of industries such as: mines & aggregates, infrastructure, transportation, defense, agricultures, oils & gas
Size	5	40 employees	7 employees	5 employees	180 employees

					4 offices: Toulouse, Paris, Los Angeles and Singapore.
Length of interview	1:36:06	1:24:22	1:33:03	1:10:43	00:49:48

Characteristics	C11	C12	C13	C14	C15
Founded in	2014	2015	2013	2007	1975
Brief description	**Start-up 8** Optimization of air traffic management around airports using satellite data helping airlines, airport operators and other air navigation service providers to reach their full capability	**Start-up 9** Offers "*ready-to-use*" in-orbit space systems with lower cost and shorter design times compared to traditional satellites	**A space chair** focusing on legal, social, economic and managerial issues confronting space activities and, especially, those raised by generalization of use of satellites and multiplication of space applications	Major European and global operator in space industry. Specializes in space infrastructures, such as satellites, international space station and interplanetary waves	European Space Agency: Its mission is to shape development of Europe's space capability and ensure that investment in space continues to deliver benefits to citizens of Europe and the world
Informants	Founder and CEO Technical leader for satellite tracking, specialized in architecture	Founder and CEO Former Airbus Space and Defence employee	2 co-directors	Vice-president Innovation: 27 years' experience with technical (satellite manufacturing), marketing and strategic responsibilities	Director of Technical and Quality Management Head of ESA's European Space Research and Technology Centre business angel
Secondary data	Reports Demonstrations of technology performance	-PowerPoint presentation -Website -Internal reports	Internal and external reports Participation in team meetings	External reports Internal reports	Website Internal reports External reports
Upstream and/or downstream	Downstream	Upstream		Upstream	Upstream and downstream
Nature of innovation	A set of software based on satellite data: arrival manager, departure manager, surface manager, 4d live trajectory predictor, parking manager	Cubesat satellite: a square-shaped miniature satellite (10 cm x 10 cm x 10 cm), weighing about 1 kg		Some of most important innovations are: geostationary meteorological satellites, Eutelsat Konnect, BlackSky: constellation of 60 future Earth Observation satellites	A variety of cutting-edge new space innovations (e.g., observing the earth, human spaceflight, launchers, navigation, telecommunications).
Size	5 employees	7 employees	23 members	7980 employees	22 member states

Length of interview	01:15:01	01:30:00	1:27:21	02:23:47	02:01:19

Characteristics	C16	C17	C18	C19
Founded in	2014	2012	1961	1975
Brief description	**A global space leader in satellite navigation**. Provides all capabilities to support implementation of satellite navigation systems, space and ground infrastructure, operations and services	University Technology Transfer Officer. Core business is to invest in technological development programs, based on academic research. Collaborates with 2 aerospace engineering schools	Centre National des Etudes Spatiales (CNES): French Space Agency, a government organization. Service of Space Prospective & Economic Impacts. Mission is to measure transformative impact of space activities on economies and industries	Regional European Space Agency
Key informants	Head of Department of Space Systems	Director of Aeronautics, Space, Transport and Digital Applications Cluster, responsible for managing technology transfer process from University to the private sector. Co-manager: Responsible for start-up creation	Expert on Space Prospective & Economic Impacts and responsible for economic intelligence unit. 18 years' experience in space-based downstream services	Former director
Secondary data	External reports Internal reports	External reports Internal reports	External reports Internal reports PowerPoint presentations	Website Internal reports External reports
Upstream and/or downstream	Upstream		Upstream and downstream	Upstream and downstream
Nature of innovation	Some of the most important innovations are: Galileo navigation program and GNOS V3 system, the second generation of the European Satellite			A variety of cutting-edge new space innovations (e.g., observing the earth, human spaceflight, launchers, navigation, telecommunications)
Size	40, 000 employees	40 employees		2200 employees at the European level (22 countries)
Length of interview	02:02:51	01:06:04	1:15:46	1:29:21

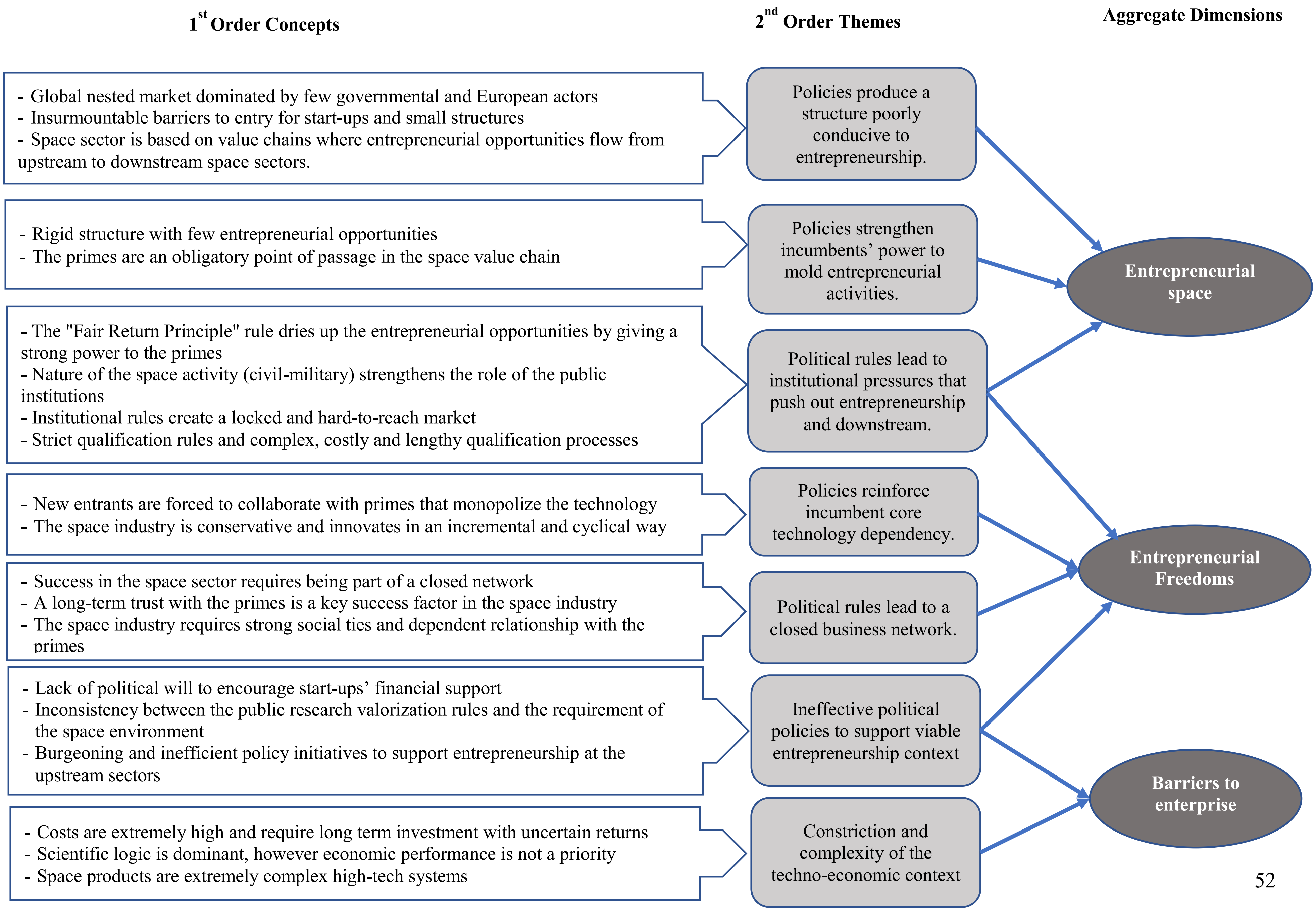

Figure 1. Data Structure

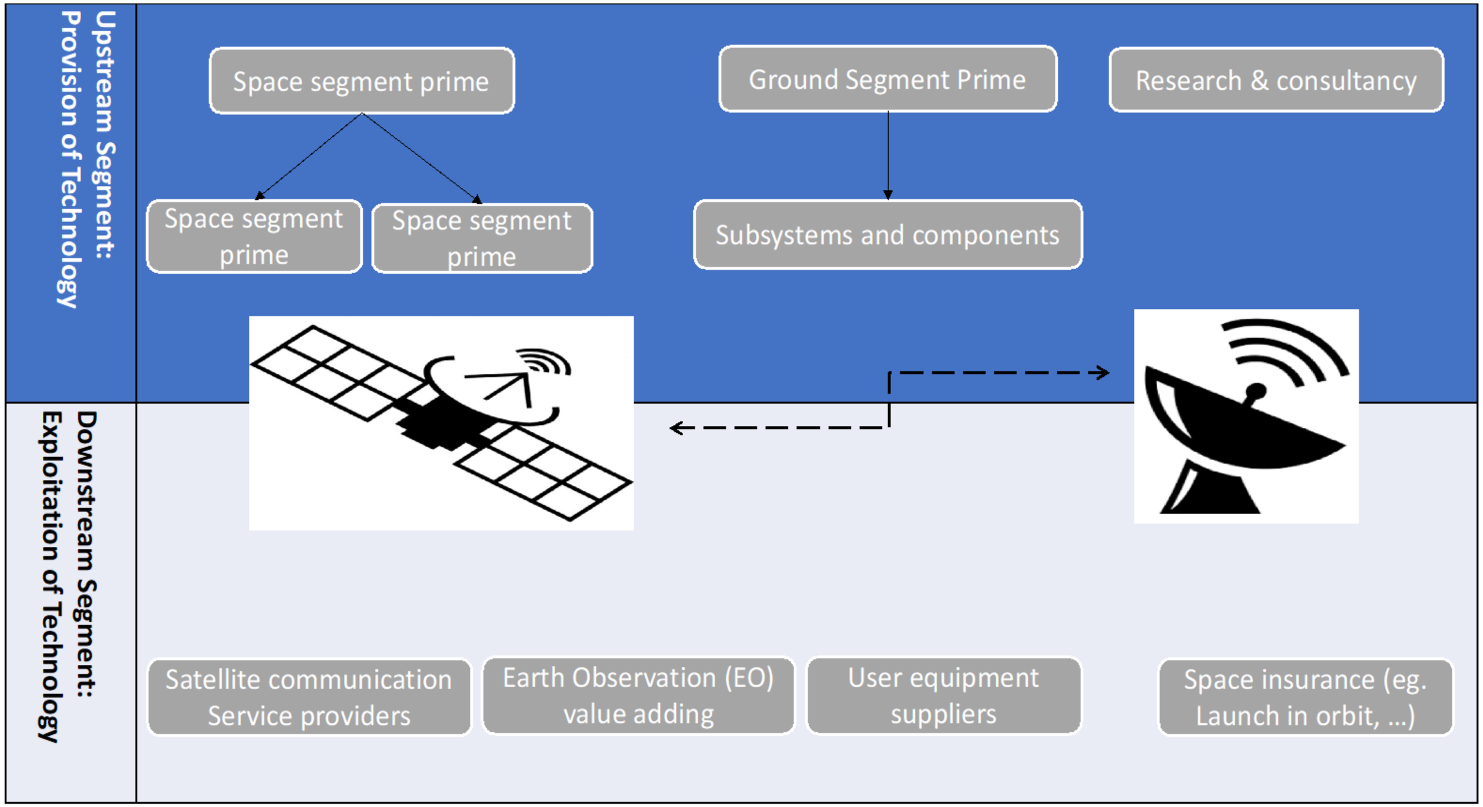

Figure 2: Space industry structure