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Successful market entry in the European commercial space industry

by

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Chapter 1

Management Summary

New entrants have the capabilities to stimulate disruptive innovation in space technology which is desirable from a government point of view as innovation in space technology is thought to strengthen a nations global competitiveness. It was only in the past ten years that new entrants found firm ground in the commercial space industry which was previously dominated by a small number of large multinational players. For that reason, little is known about factors that contribute to successful market entry in commercial space. In general, very little is known about these new entrants in the commercial space industry; how many new entrants are there, how do they organize themselves and in which market segment do they operate.

The aim of this research is to investigate successful market entry of the so called new space companies, private space companies that were founded around or later than the year 2000. The objective of this research is to identify determinants for successful market entry in European commercial space so that the current policy instruments of the European Union can be revised and improved in order to stimulate market entry. Determinants of successful market entry refer to decisions that the entrepreneur makes related to and before entering the market in question. As the field of market entry in commercial space is still unexplored, it was not possible to identify potential candidates for determinants in literature. Therefore, a general approach was chosen; analyzing the market entry strategies of new entrants in European commercial space. From literature it could be concluded that business models are of specific interest for new space companies as they are generally said to have "innovative business models". Also the space industry appears to be quite difficult to compare to other industries as it has very unique characteristics, among others the strong presence of governmental organizations and the high entry barriers.

It was hypothesized that business models and market entry strategy could therefore be predictors for successful market entry in European commercial space. Furthermore it was hypothesized

that these relations would be influenced by market entry barriers and policy instruments as these are specifics of the space industry.

Literature research was performed in order to identify characteristics and trends in the European commercial space industry and to provide background information on the relevant concepts: business models, market entry strategies, market entry barriers and policy instruments. The following concepts appeared to be not well defined: new space, business model, market entry strategy and market entry mode. This made it difficult to operationalize the theoretical framework.

A multiple case study was performed involving six Dutch new space companies that have successfully entered or are in the process of market entry in the European commercial space market. The characteristics and problems of the Dutch space sector are described in order to indicate which results describe the European commercial space industry and which results are specific for the Dutch space sector. Reference class forecasting was used to identify similar decisions within the scope of business model and market entry strategy.

The results of this research provide argumentation for hypothesizing that both business models and market entry strategy are related to successful market entry. This is because 1. the researched companies show similar market entry strategies and business models 2. potential determinants can be identified (which are similar decisions for all companies) and 3. because a reaction to entry barriers and policy instruments seem to be included in the design of market entry strategy and business model. These three points will be shortly discussed here-under.

The business model that was recognized in all the researched new space companies can be referred to as the end-to-end model. These companies invested in space hardware so that they could become a service provider selling mainly services based on space data. These companies take care of the space hardware manufacturing, the launching, operating of both space hardware and ground segments and even the processing of the space data into a valuable service. This is a new model in the space industry as space actors usually performed only one activity in the space value chain. The new entrants thus do not position themselves somewhere in the value chain, but take care of the complete value chain themselves. The market entry strategy that was found in almost all the new space companies can be described as a niche strategy and a strategy that includes a partner, either in a strategic alliance or with a launching customer.

This study resulted in the identification of five potential determinants within the scope of business model or market entry strategy. These determinants are suggested to be predictors for successful market entry in European commercial space: International market development,

value chain integration, being a service provider, having a relevant network and being able to lower the start-up costs.

It was found that the researched companies reacted to entry barriers and in some cases policy instruments by designing their business models and market entry strategies in a specific way. The market entry strategy and business model appear to be mutually dependent in this research. It is hypothesized that the design of business models and market entry strategies is a parallel process which takes place prior to market entry. Different configurations of the market entry strategy and business model are combined to investigate which combination aligns best with the market factors. By the end of the process all these components should be aligned in order to enable market entry.

This study is the first, to my knowledge, that researches market entry in the European commercial space industry. Further research is required to validate the factors for successful market entry and to find the relative contribution of these factors to successful market entry.

Chapter 2

Introduction

2.1 General introduction

The United States (US) and the Soviet Union (SU) were the first nations that realized access to space during the so called space race in the time of the cold war(Krige and Russo, 2000). Europe could not stay behind and founded the European Space Agency (ESA) in 1975 in order to collectively gain access to space. Via ESA, the financial and intellectual resources of all its member states (currently 22) could be united to enable large space projects(European Space Agency, 2017b). Although Europe gained autonomous access to space much later in comparison to the US and the SU, Europe currently has a world-class space sector with an estimated total value of EUR 46-54 billion in 2014 (around 21 % of the global space sector)(European Commission, 2016). The US, Russia and Europe are currently leaders in the global space industry with competitive space industries.

For a long time the space industry was primarily controlled by the government as a result of the cold war(Krige and Russo, 2000). At present, the global space industry is changing fast and is at the point of an industrial revolution(European Commission, 2016). The military space sector is no longer the most important industry as the commercial sector of the space industry is rapidly growing. The rapidly growing commercial sector is often referred to as new space and results in new industries being born. New space emerged after the consolidation wave which was a consequence of the end of the cold war when only a small number of large companies were left that controlled the entire commercial space industry (i.e. Boeing, Lockheed Martin)(Cornell, 2011). The term new space generally refers to small companies with a young workforce capable of out of the box thinking which made them competitive to the large incumbents. The emergence of new space brings new entrants into the space industry and with them new challenges and ambitions for the space industry. Some of the best-known examples include SpaceX (US), Blue Origin (US), Bigelow Aerospace (US), Planet Labs (US), Deep Space Industries (US) and Virgin Galactic (United Kingdom). The new space movement is often associated with internet

billionaires (mainly from the US) that invest in space technology, sometimes referred to as the billionaire space race(The Daily Beast, 2016; Bloomberg, 2015; The Week, 2016).

The new space companies disrupted traditional business models which resulted primarily in overall cost reduction of space technology(Cornell, 2011). However, in general, still very little is known about the current developments in the commercial space industry. This could be due to the fact that the developments are very recent, and that the commercial space industry is still very small.

New space clearly impacts the traditional space industry. The question arises if new space is something that is mainly found in the US and if so, if this would have implications for the competitiveness of other space industries, among which the European space industry which is the industry of interest for this research.

2.2 Problem definition

The European Commission (EC) needs to ensure that Europe keeps its prominent position in the global space industry that ensures Europe's autonomous access to space. The importance of having autonomous access to space can be explained by the following aspects of space technology(European Commission, 2016); First, space technology is one of the key industrial competences that determine the global competitiveness meaning that it will increase wealth and create jobs as defined by the European Commission(European Commission, 2017e). This is realized because space technology has many terrestrial applications in lots of different industries which are indispensable in everyday life. Examples include, but are not limited to, applications in transport, energy, medical, telecommunications, materials, agriculture and tourism. If Europe would be dependent on foreign countries for access to space, Europe would have a huge economical dependency which is a major risk. Second, space technology plays a vital role in safety and defence strategies. Satellites for instance are used to detect missile launches, nuclear explosions or environmental disasters. If Europe would not have autonomous access to space, Europe would not have control over its security and defence technologies, which is major strategic risk. Third, space technology supports numerous key political priorities and policies (e.g. migration and climate change). Not having an autonomous access to space would mean that Europe would be dependent on foreign countries for achieving their political goals. A prerequisite for having autonomous access to space is having a competitive European space industry, meaning that Europe has the capabilities to build state of the art space technologies itself. This line of argumentation is summarized in Figure 2.1.

The current changes in the space industry, in particular the aforementioned growth of the commercial space sector in especially the US, appears to challenge the global competitiveness of Europe. ASD Eurospace, the trade association of the European Space Industry, states the following: the competitiveness of the European space industry is constantly challenged at the

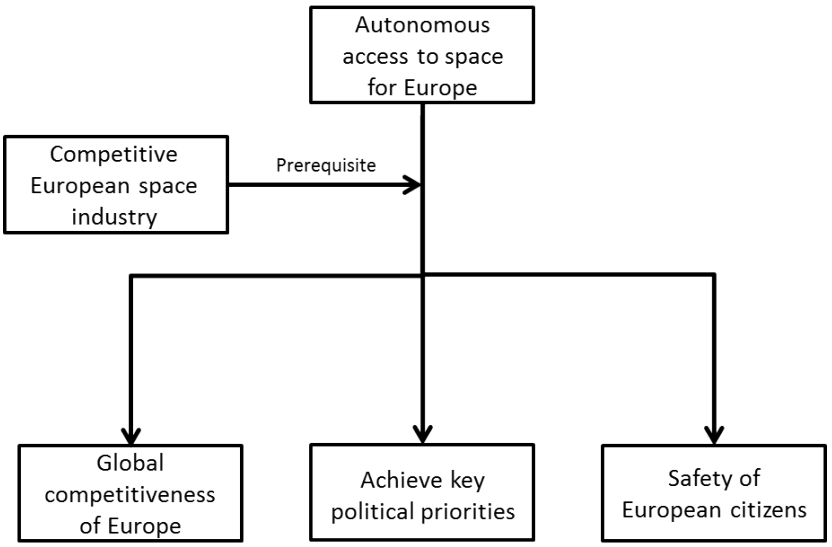

FIGURE 2.1: Problem definition: The goal is to have an autonomous access to space which can be achieved by having a competitive space industry. Autonomous access to space results in three substantial advantages for Europe: Global competitiveness, Achieving key political priorities and the safety of citizens

international level with the emergence of disruptive new players and new forms of industrial organizations(ASD Eurospace, 2016a). Therefore, Europe needs to react to current changes in the space industry so that it will remain a global leader in space and will be able to benefit from the opportunities offered by state of the art space technology(European Commission, 2016). It is essential that the commercial space sector in Europe experiences growth as well. Growth of the European commercial space sector in itself is not enough to maintain a competitive space industry. Europe also needs to foster entrepreneurship and new business opportunities in the industry in order to keep up with global emergence of new space companies.

The uptake of disruptive new entrants like new space companies in the commercial space industry cultivates disruptive innovation which is likely to contribute to the industry's global competitiveness. Disruptive new players bring entirely new value propositions to the market, so are likely to attract new customers and therefore discover new applications of space technology in a variety of industries which finally leads to growth of the commercial sector. New entrants are pre-eminently suitable to introduce new value propositions as they do not have an existing customer base which they have to maintain by providing products suited to their needs.

The central problem identified in this work is that the global competitiveness of the European space industry is currently facing challenges which poses a risk for multiple European privileges (Figure 2.1). The approach chosen is to research how disruptive new players like new space companies can successfully enter the European commercial space industry. This knowledge can be used to increase the uptake op new space companies, which was identified as a mean to strengthen the global competitiveness of the European space industry. This is summarized in Figure 2.2.

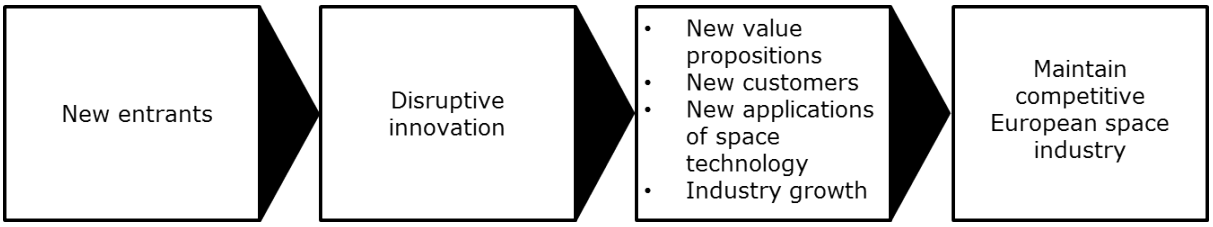

FIGURE 2.2: Approach: Stimulate the uptake of new entrants in order to trigger disruptive innovation which leads to new value propositions, new customers, new applications of space technology and industry growth. Finally contributing to maintaining a competitive European space industry.

Market entry in the European commercial space industry is a challenge in itself. Europe does not have many billionaire investors able to invest in space technology creating a European billionaire space race, thus Europe has to come up with another approach. Furthermore, Europe does not offer favourable conditions for entrepreneurship(World Economic Forum, 2014) and history shows that the space industry in specific is not attractive for Small and Medium-sized Enterprises (SMEs) and start-ups, the main types of new entrants(Summerer, 2012). European governmental entities like the EC and ESA acknowledge this, and therefore provide policy instruments (e.g. financial support, business incubators) to help new entrants in accomplishing successful and preferably disruptive market entry in European commercial space.

At the moment, the European commercial space industry does know some successful disruptive entrants with new business models(Toulouse space show, 2016). These examples are not many, not very well-known and are most often not backed by billionaire investors. It is thus unknown if Europe is able to keep up with the new space developments in other parts of the world (e.g. the US). It is assumed that other parts of the world offer more favourable conditions for new space developments in comparison to Europe because of aforementioned reasons (not many billionaires, no favourable conditions for entrepreneurship in general). It is therefore of great relevance to research how market entry in the European commercial space industry can be realized. At the moment, it is yet unclear how new entrants successfully entered the commercial space market. The market entry strategies of these entrants have apparently been very effective in overcoming the entry barriers of the commercial space industry. Important lessons can thus be learned from these new successful entrants in order to increase the uptake of new space companies.

2.3 The conceptual model

This Section will discuss the conceptual model of this study. The conceptual model is a schematic representation of the interrelations between the different concepts relevant for this study. The initial conceptual model should be a logical conclusion from previous literature in the area of interest (Sekaran, 2003). A good conceptual model identifies the type of variables that

are relevant in the study, discusses the interrelationships between the variables and provides argumentation for why these relationships exist (Sekaran, 2003). The concept of interest for this study is successful market entry so a short literature research on this topic will be presented in this Section in order to identify which concepts are relevant to include in this research. This Section will conclude with a schematic representation of the conceptual model.

The aim of this research is to analyze how successful market entry in the European commercial space industry can be realized. In this research, successful market entry will refer to the initial production of a product or provision of a service (Helfat and Lieberman, 2002). Market performance is out of scope for this research because it is assumed that it is most important that new value propositions will reach the market. It is assumed that, when new value propositions reach the market, it will attract at least some new customers and it will lead to the discovery of at least some new applications of space technology. The impact of these new value propositions could be very small, but even small contributions might eventually advance the industry and finally increase the global competitiveness of the European commercial space industry. Horn et all researched successful market entry and list multiple general predictors for successful market entry namely: Size of entry relative to minimum efficient scale, relatedness of the market entered, complementary assets, order of entry, industry life cycle stage, degree of technological innovation(Horn et al., 2005). Horn et all discuss that key determinants for successful market entry can be identified for a specific market. In other words, not every general predictor for successful market entry is relevant in every market. Examples of key determinants are given in the research by Horn et all: business models, marketing, distribution. Horn et all do not define the concepts "succesfull market entry", "predictor" and "key determinant" in their work. However, from their research it is clear that successful market entry can be predicted in some way. The "predictors" or "key determinants" of successful market entry refer to decisions that the entrepreneur makes related to and before entering the market in question. This research will use the term "determinant" in order to describe such a decision that (presumably) leads to successful market entry.

There are no previous studies known that have already analyzed successful market entry in the European commercial space industry and therefore it is unknown what specific predictors might be. Therefore, a more general approach is chosen. The concept market entry strategy refers to a company's goals, plans and decisions in regard to which market to enter, when to enter, and how to enter (taking into account opportunities, threats, and customer needs) as defined by Leih and Teece(Leih and Teece, 2014). The concept of market entry strategy is very broad and includes argumentation for the decisions made prior to market entry. Describing the market entry strategy of a new entrant would provide insight into determinants of successful market entry in European commercial space. When researching the concept market entry strategy, it is most often associated with international expansion of an existing (multinational) firm(Buckley and Casson, 1998; Zahra et al., 2000; Agarwal and Ramaswami, 1992). Not much research

on market entry appears to be dedicated to small de novo companies (Nisar et al., 2017) and not a lot of literature can be found on domestic market entry. Start-ups have very different characteristics than multinational firms so literature that describe market entry strategy based on multinational companies might not be relevant.

One of the concepts that appear to be of specific interest for new entrants in commercial space is "business model" as multiple scholars mention that new space companies invented new business models which disrupted the space industry and made the companies competitive to incumbents(Vecchi and Brennan, 2015; Cornell, 2011). Vecchi et al argue that business model innovation is a determinant for 'operating successfully in the space industry'(Vecchi and Brennan, 2015).

In this study, the concept business model is defined as: a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams"(Osterwalder et al., 2005). This study is interested in describing the specific business models that new entrants choose and how these decisions could influence successful market entry in order to identify specific determinants.

Reference-class forecasting is a powerful tool for researching determinants for successful market entry. This method involves creating a so called reference class, which is a group of companies that have made the same decisions in the past. Making a rough distribution of the outcome of these decisions has been proven to be quite an accurate method of forecasting (Lovallo and Kahneman, 2003). Therefore, companies that have successfully entered the European commercial space market probably have made some similar decisions. These particular decisions can be identified as potential determinants for successful market entry. The reference class that needs to be constructed is a group of companies that have successfully entered the European commercial space industry.

Researching the concepts market entry strategy and business models independently might be quite difficult as the concepts strategy and business model are quite similar and are often confused (Hedman and Kalling, 2003; Seddon et al., 2004; Seddon and Lewis, 2003; Casadesus-Masanell and Ricart, 2010). There is no consensus about the exact difference between the concepts. Ricard et al state that a firm's business model is 'the reflection of the firm's realized strategy'(Casadesus-Masanell and Ricart, 2010), Seddon et al define business model as 'abstract representation of some aspect of a firms strategy; it outlines the essential details one needs to know to understand how a firm can successfully deliver value to its customers'(Seddon and Lewis, 2003). Furthermore, Seddon et al state the business models are defined first and that strategy can be designed from the business model. However, the choice for a specific business model could also be part of the market entry strategy.

The overall goal of this study is to define determinants, defined as choices made by the entrepreneur in question prior to market entry that can be related to successful market entry in European commercial space. The concepts market entry strategy and business models will be separately included in the conceptual model as independent variables. However, their relation will be analyzed in this study as this also might provide insights into successful market entry.

It is of importance to investigate if there are any relevant moderating variables that affect the strength of the relation between the independent and dependent variables. The space industry is often described as being a very unique industry with specific characteristics, thus it is of importance for this study to identify concepts that are characteristic for the space industry and which could be related to successful market entry.

The space industry is often recognized for its high entry barriers (e.g. extremely high investment costs, high degree of government involvement)(Summerer, 2012; Stefan, 2014). The amount of and the type of entry barriers that a start-up would encounter when entering the commercial space market is likely to influence if a certain market entry strategy or business model would lead to successful market entry. Therefore, it makes sense to include the concept "entry barriers" in this study as a moderating variable, as entry barriers are very characteristic to the space industry and are known to be related to market entry.

Furthermore, due to the high government involvement in this industry, many policy instruments exist. As governmental organizations have already identified increasing the amount of new entrants as a mean to increase global competitiveness, many policy instruments exist that are specifically targeted to new entrants. For that reason, the concept "policy instruments" will also be identified as a moderating variable in this study. If a company would be able to take advantage of multiple policy instrument this might influence the relation between business model and market entry strategy with successful market entry.

Summarized, it is hypothesized that the concepts business model and market entry strategy, which are presumably to a certain extent mutually dependent, have a relation with successful market entry in the context of European commercial space. Therefore, the business models and market entry strategies of successful European start-ups in the commercial space industry will be described and analyzed.

If the companies share some of the decisions, made within the scope of market entry strategy or business model, this can be identified as a determinant successful market entry. The presence of such shared decisions (determinants) can be used to support the hypothesized relation between business models and market entry strategies with successful market entry. Potential determinants might be for instance the choice for certain business partners or specific type of distribution channel(s). Knowledge about these determinants for successful market entry can then be used by government organizations to develop or review European policies that aim to stimulate space entrepreneurship. Policy instruments could for instance facilitate the encounter of new entrants with certain partners if this turned out to be an important determinant.

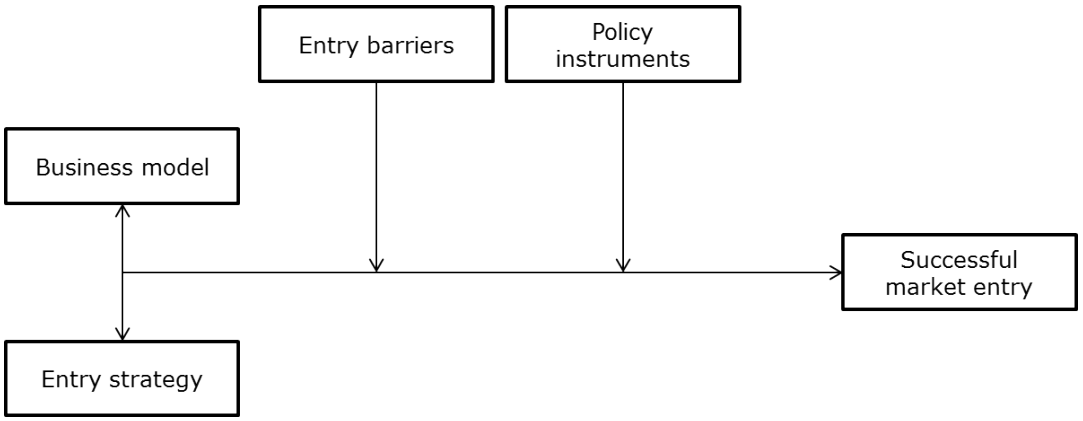

FIGURE 2.3: The conceptual model

The conceptual model is shown in Figure 2.3. A new and more detailed conceptual model could be constructed based on the results of this research.

The dependent variable is the variable of interest for this study, which is successful market entry. The goal is to finally understand and describe the dependent variable. The independent variables influence the dependent variable. This study hypothesizes that successful market entry is influenced by both the market entry strategy and the business model of the entrant in question. Thus, business model and market entry strategy are the independent variables in this model. Market entry barriers and policy instruments were identified as potential moderators, meaning that they influence the relation between the independent and dependent variables. The argumentation for the existence of these relationships will be explained in more detail in the literature review in Chapter 4. Furthermore, Chapter 5 (Methodology) will describe in detail how to examine these variables.

2.4 Research objective & questions

The objective of this research is: to compare and describe various business models and market entry strategies of successful start-ups in the space industry so that determinants for successful market entry can be identified and subsequently used to make recommendations for European policies that aim to increase the number of new entrants in the space industry.

The main research question related to the research objective is:

Within the scope of the concepts business model and market entry strategy, what are determinants for successful market entry in the European commercial space industry?

Various sub-questions were identified that will collectively answer the main research question. First of all, the European space industry needs to be characterized in order to get a good insight in this specific industry:

- What are the characteristics of and trends in the European commercial space industry? This sub-question will be answered in Chapter 2.

Subsequently, research questions involving the independent variables need to be formulated:

- What are the business models of space start-ups and how are they related to successful market entry in European commercial space?
- What are the market entry strategies of space start-ups and how are they related to successful market entry in European commercial space?

Furthermore, research questions involving the moderating variables:

- What are the entry barriers that space start-ups encounter and how do they influence successful market entry in the European commercial space industry?
- What are the policy instruments that space start-ups use and how do they influence successful market entry in the European commercial space industry?

Then, the various business models and market entry strategies of the start-ups need to be compared and similarities need to be identified in order to find determinants for successful market entry. The factors that all successful start-ups share are most likely to be determinants for successful market when using the method reference class forecasting.

- Which similarities can be identified as determinants in the business models and market entry strategies of successful start-ups operating in the European commercial space industry?

The identified determinants for successful market entry should then be translated into recommendations for a European policy that aims to stimulate space entrepreneurship. In order to answer this question, it should first be clear which policies that aim to increase the number of start-ups in the European space industry are currently in place. The current policies will be reviewed in chapter 3.

- How can the current European policies be improved so that more start-ups will emerge in the commercial European space-industry?

2.5 Research approach & design

This research approach is qualitative and the research design involves a multiple case study. The unit of analysis is on the company level. Six cases of Dutch space hardware producing companies will be analyzed in this study. The method of data collection in this study is interviews. Argumentation for the approach, design and unit of analysis will be provided in Chapter 5.

2.6 Practical & scientific relevance

This study is both of practical and scientific relevance which will be explained in the following subsections.

2.6.1 Practical relevance

Knowledge about determinants for successful market entry is of practical relevance for both entrepreneurs and governmental entities. First of all for entrepreneurs as their interest is to produce a product or to provide a service for a specific market (successful market entry). Entrepreneurs can use the determinants when they decide on the design of their market entry strategy or business model. Many entrepreneurs do not succeed and therefore many potentially innovative products or services will never reach the market. If knowledge about determinants could increase the number of entrants in the commercial space industry this is both relevant for entrepreneurs and governmental entities. Commercial space is expected to become a very important industry, which is underpinned by the fact that space technology is named a key industrial competence by the EC. Policy makers can use the knowledge about determinants to review and develop European policy instruments so that these instruments could facilitate certain decisions that are identified as determinants for successful market entry. In the end, policy makers would benefit from an increased number of entrants in the European commercial space market as this is assumed to maintain or achieve a globally competitive Europe. Global competitiveness results in increased wealth and the creation of jobs which is of importance to all people living in the European Union (EU).

2.6.2 Scientific relevance

The scientific relevance of this research can first of all be assured by the novelty of this subject. New space emerged around the year 2000 and it is only recently (taking the foundation of New Space Global in 2011 as a point of reference) that commercial space actually attracted new players. Therefore, little is known about their business models and market entry strategies. The literature on business models and market entry strategies and their interrelation is still very divided so researching these concepts contributes to their understanding. Furthermore, this research will contribute to literature on domestic market entry strategies by start-ups. The available literature on market entry mainly focuses on international market entry by multinationals. Finally, this research allows the investigation of the relation between the concepts of business models, market entry strategy, market entry barriers and policy instruments, contributing to scientific literature on these topics. It is not obvious to relate business models to entry barriers as business models are often thought ignore the aspects of the market. This research argues, that in the special case of the space industry, business models might be influenced by

entry barriers or policy instruments. This might result in new insights on the use of the concept business model in relation to the concept market entry.

2.7 Thesis outline

Chapter 2 is meant to provide a general overview of the topic under discussion in this study. An introduction to the problem was given and the research questions and general research design were presented. Chapter 3 will characterize the European commercial space industry, aiming to answer research question 1. Chapter 4 includes the literature review that was conducted in order to clarify the theoretical concepts used in this research. Chapter 5 will describe in detail the research methods that are used in this study. Then Chapter 6 will present the analysis of the interviews, the results of this research. In Chapter 7, the results will discussed and the conclusions of this research will be presented. Finally, Chapter 7 will also discuss the implications and limitations of this research and suggestions for future research will be provided.

Chapter 3

The space industry

This Chapter will provide further background information on the characteristics of the space industry.

3.1 Literature review method

For the literature review (both Chapter 3 and Chapter 4), the following search engines / databases were used to collect literature: Sciencedirect, Google Scholar and Scopus. Keywords used to collect literature were innovation, disruptive innovation, radical innovation, space, aerospace, new space, commercial space, private space, business model, entry barrier, market entry, Europe, European, ESA, European Space Agency, NASA, National Aeronautics and Space Administration. Mostly a backward snowballing approach was used and the following journals were explored: Acta Astronautica, New Space, Space Policy, Air & Space Europe. Furthermore publications of NASA, ESA, New Space Global, the Organization for Economic Cooperation and Development (OECD), Eurospace and the EC also contributed for a large extent to the literature review. The main topic of this research, market entry in European commercial space is a relatively novel topic thus no research covering exactly this topic was found.

3.2 The context of the space industry

This Section will give an introduction to the context of the space industry. This information is not needed for the line of argumentation in this study but does provide insight in some important characteristics of the industry.

3.2.1 The beginning of the space age

In order to understand the characteristics of the space industry, a small overview of the history of space technology is presented in this Section.

The first rocketeers were inspired by science fiction books like that of Jules Verne, H.G. Wells and Edgar Rice Burroughs (Krige and Russo, 2000). Work of rocket pioneers like Konstantin Tsiolkovskyn (Russia), Hermann Oberth(Germany) and Robert Goddard (US) led to the emergence of rocket societies of amateur enthusiasts in the 1920s and 1930s. These societies did not had the resources to conduct serious research and development nor to produce any space products. So actual space programmes started in the time between world war I and world war II, funded by the military, in particular in Nazi Germany and the Soviet Union. By the end of world war II, several German rocketeers among which the famous Wernher von Braun were captured by the Americans and continued their work oversees. The Soviets benefited from the rocket technology of the Germans as well as they were able to capture a large number of rocket engineers as well.

Subsequently the cold war started in 1947 where serious efforts were done to develop innovative space technology, namely rockets to carry nuclear warheads and satellites for the purpose of strategic reconnaissance. Both the United States (US) and Union of Soviet Socialist Republics (USSR) entered the so called space race which represented the competition for space exploration achievements. Motivated by political, ideological and military interest, the US and the USSR wanted to prove their superiority to the world. Politics and military objectives were not the only drivers for the space race, as space programmes also meant interesting new fields of scientific research and important applications for future technologies in the field of e.g. meteorology and telecommunication. Milestones generally used to mark the beginning and the end of the space race is the launch of the first satellite Sputnik I in 1957 by the USSR and the joint US-USSR Apollo-Soyez project in 1975 respectively (Krige and Russo, 2000). Simultaneously the need for an open and peaceful civilian space agency emerged, therefore the National Aeronautics and Space Administration (NASA) was created in 1958 which took over all aspects of the American space programme except for those having a direct military application. The space act gave NASA the unique authority to collaborate with any entity that is able to advance NASAs mission and program objectives, including international cooperative space activities. In 1959 NASA offered to launch scientific equipment for scientists from other countries which resulted in the first cooperative programmes of NASA and other countries.

In Europe, the UK, France, Italy and Germany were also active in the research and development of space technology but could by no means keep up with the developments in the Soviet Union and the USA. In 1961 a supranational body with seven members was created (Belgium,

the Federal Republic of Germany, France, Italy, the Netherlands, Switzerland and the United Kingdom) founded Eurospace with the aim to promote space activities in West-Europe.

The European Space Agency (ESA) was founded in 1975 and currently consists of 22 member states which unite intellectual and financial resources in order to enable large projects far beyond the scope of a single European country. Only government organizations like NASA/ESA could afford flying rockets to space thus only few space launch system manufacturing companies exist as the market is very small (e.g. Boeing, Lockheed).

When innovation was cold war driven, much technological progress was made. The move from cold war driven competition to cooperation and the associated change in motivations had substantial consequences on the way space technology and innovation in and for space have been conducted. In parallel, and similarly important, some space activities have generated new commercial markets (e.g. telecommunications) and are now driven more by economic, market oriented decisions than by governmental ones. Space agencies (civilian and military), traditionally the main funding bodies, for advancing space related technologies and concepts have been adapting to this change by diversifying their innovation and technology development strategies. The innovation environment for space activities has changed substantially over time. The decreasing share of governmental, strategy- and defence-driven technology push has increased the difficulties for space applications and space solutions to remain competitive with terrestrial solutions.

In 1970, NASA began to look for possibilities to outsource the use of its launching facilities and services to private companies such as COMSAT, RCA, and Western Union. This search was due to the fact that maintaining, modifying, launching, and other duties required to launch expendable launch vehicles cost upwards of billions of dollars. Upon realizing the economic benefits of utilizing private space companies, the House Science and Technologies Commission proposed H.R. 3942 which eventually became Public Law 98-575, or the Commercial Space Act of 1984. NASA has collaborated with American private-sector individuals and companies investing in space exploration, collectively known as "emerging space." NASA has employed many different strategies to attract private companies in the space industry. Up to 2014, NASA has invested over $5.7 billion in commercial partners located throughout the United States as part of the agency's commitment to develop the nation's emerging space industries. Many incentives (e.g. new business incubators, special funding for small businesses) are especially dedicated to help small companies enter the space market as a strategy to drive innovation in the space industry. Similarly, ESA also funds and cooperates with small businesses that have the ambition to enter the space market. And with success, as private spaceflight now accounts for a majority of the total space industry. The government led space industry characterized by a high degree of concentration and vertical integration of manufacturers is often referred to as Old Space while the term New space (or commercial/entrepreneurial space) is used for the diverse and innovative private spaceflight industry.

More background information on the definitions of old and new space and public and commercial space will be provided in the following Sections.

3.2.2 Space capability

The aim of this Section is to provide an overview of the nations having access to space and space capabilities worldwide. First of all, an overview of the space faring nations will be provided in this Section.

A space faring nation is defined as "A nation with the ability to access space capabilities using their indigenous space systems" (The Free Dictionary, 2005).

A distinction can be made between crewed launched and uncrewed launches. The only nations currently capable of crewed missions are (date of first crewed launch in parentheses) (Leloglu and Kocaoglan, 2008):

- Soviet Union/Russia (1961)
- USA (1961)
- China (2003)

Furthermore these nations or organizations that have the ability to launch uncrewed spacecraft into orbit either from their own or from a foreign territory (date of first uncrewed launch in parentheses):

- Soviet Union/Russia (1957)
- USA (1958)
- Canada (1962)
- Italy (1964)
- France (1965)
- Australia (1967)
- Japan (1970)
- China (1970)
- United Kingdom (1971)
- European Space Agency (1979)
- India (1980)

- Israel (1988)
- Ukraine (1991)[5]
- Russia (1992)
- Iran (2009)
- North Korea (2012)
- South Korea (2013)

3.2.3 European space versus rest of the world

Space technology is recognized for its economical and scientific benefits, however these benefits are not always understood properly. Space technology is part of the daily lives of European citizens as it is used in mobile phones, for financial transactions, climate monitoring, natural disasters, agricultural and maritime policy, security and many others. Space technology has a clear strategic component since Europe is very dependent on space technology, and therefore vulnerable. Having an independent space industry and not being reliable on foreign technologies is therefore much wanted by European policy makers. An independent European space industry refers to Europe being able to design, build and operate state-of-the-art space systems safely and to sell these on the domestic market. Currently, Europe does not have an independent space sector. An example of this is that it was estimated that on average 60% of the electronics incorporated in European satellites is imported from the USA(ASD Eurospace, 2016a).

The European space sector is small compared to that of the USA, both in employees (38.000 employees against 250.000 employees in the USA in 2014) as in accessible government budget (7,0 bn dollar in 2015 against 17,6 bn for the USA). This can be explained by the fact that European public demand is not stable and not as significant as opposed to other space faring nations where the government can be seen as the guaranteed basis for developing a domestic space industry(ASD Eurospace, 2016a). There are for instance limited military programmes related to space technology and there is no ambition for manned spaceflight with European-made spacecraft. The result is that the total government budget, the budget spend on R&D and the domestic market is much smaller than that of other space faring nations like USA, Russia and China. Only 36% of the sales of the European space industry is for the local institutional market opposed to 60% in the USA meaning that Europe is very dependent on the dynamics of the commercial markets. Nevertheless, the value of the European space market was estimated at 46-54 bn in 2014 which is roughly 21% of the global space sector. The European satellite manufacturing industry performs even better with a global share of 33% (European Commission, 2016).

3.3 The actors in the space economy

The space economy involves a lot of different actors. First of all, two different markets can be defined: The institutional market and the commercial market as already referred to in Section 3.2.1. The institutional market refers to the need for space products articulated by public customers. Public customers are state controlled or owned entities and are, in the case of the European space market, mostly space agencies in the EU and abroad or public satellite operators (Eumetsat in Europe or Arabsat, Chinasat, RSCC worldwide). As space products are expensive, for a long time the public customers were the only customers for space products. As described, the commercial market is still growing and refers to private customers interested in buying space products. According to M. Grimard, the supplier side of the space industry consists of the following actors (Grimard, 2012):

- Space system manufacturers
- Launch operators
- Space operators
- Service providers that control ground stations

The space value chain can be divided in up- and downstream actors where downstream actors encompass the companies which provide services or products to the final consumers (Space safety magazine, 2017). The different of actors in the space value chain will be further discussed in the following subsection.

3.3.1 The space value chain

The space system manufacturing level consists of actors which build, design and develop space systems like launchers, spacecraft and the related professional ground segments. The manufacturing level can be further subdivided in primes that integrate all components and are thus a supplier of full space systems, satellite primes which supply complete satellite and lastly equipment suppliers. The manufacturing level is generally seen as the classical space industry which has a close collaboration with the defence sector.

A recent trend within the manufacturing segment is the global emergence of new small private primes (i.e. SpaceX, SSTL, Bigelow). This is a remarkable trend as primes are generally large multinational companies (i.e. Boeing, Lockheed Martin) because the investment for large infrastructures and medium to heavy launchers are in the range of billions and have a development time ranging from 7-15 years. The investment required for telecommunications, earth observation or science satellites and small launchers is usually in the range of a hundred million. And even the investment required for equipment companies can already reach up to tens of millions.

Small new companies generally did not have the resources to enter this segment of the space industry but that seems to be changing.

The launch operators are the actors that deliver the satellites into orbit. There are less than 10 launch operators in the world and they are generally daughter companies of the manufacturing companies (Arianespace shareholders are the European launcher industry and CNES, ILS is owned by Khrunichev, ULA is a joint venture of Boeing and Lockheed Martin). SpaceX can again be used to illustrate changes related to the emergence of new space as SpaceX also has close collaboration with both the National Aeronautics and Space Administration (NASA) and the Department of Defence in the US.

The satellites are operated and owned by the satellite operators which sell services such as communications bandwidth. There are three different types of satellite operators depending on the services they provide: telecommunications, earth observation and lastly navigation. In the case of telecommunications, there are around 30 actors in the world where the top 4 represents about 60% of the total revenues (SES, Intelsat, Inmarsat, Eutelsat). The commercial business in telecommunication is rather mature as most of the actors have been acquired by private equity funds over the past 15 years. The satellite operators that are focused on earth observations have a long history of being owned and operated by governments. Furthermore, the civil signal is offered for free worldwide. The commercial business is therefore not mature and the main private actors are GeoEye, Digital Globe, and Spot Image. Navigation is the segment of satellite operators that have no commercial actors yet. The only existing positioning systems are GPS, Glonass and Beidou and those are owned by governments and are mainly used for military purposes. Creating a commercial service is currently one of the main challenges for the Galileo operator(Eur-lex, 2017).

The most downstream of the space value chain are the service providers that buy the data or services from the satellite operators and control ground networks and stations to deliver their own services which for example are communications services or geo-information services that can be used by consumers. The highest profits are realized within this segment of the space industry. Many different companies are active in this level of the value chain (i.e. many telecommunication companies but also small start-ups which are focused on niche market segments).

Most of the private commercial businesses are service companies that supply either the mass market (with services like telecommunication) or the institutions and corporates (with services like military communications, land mapping).

Furthermore, space technology can be used in non-space applications like health or tourism. Non-space applications are not part of the space industry but can generate profits for the space industry via licensing of the technology for instance.

There is no data available on where exactly the new entrants position themselves in the space value chain.

3.4 The space manufacturing industry

The focus of this research will be on new entrants in the European space manufacturing industry, often named the upstream segment. The space manufacturing industry designs, develops and builds space systems (launchers, spacecraft and the related professional ground segment). Service providers like satellite operators or launch service providers are therefore not part of the manufacturing industry, but are customers of this industry. This section will provide a general overview of the European space manufacturing industry with emphasis on new entrants and the Dutch upstream space segment.

3.4.1 General introduction to the European manufacturing industry

The European space manufacturing industry is a strategic sector, part of the wider European AeroSpace and Defence industrial complex, responsible for the supply of space infrastructure. Even when taking into account that ESA has 22 member states, it can be concluded that the sector is very concentrated as four large industrial groups are directly responsible for more than half of the total space industry employment (Airbus, Thales, Safran and Leonardo). The largest business units are mainly located in Airbus Defence & Space, Thales Alenia Space and Airbus-Safran Launchers (ArianeGroup).

Figure 3.1 shows the sales and employment of the European space manufacturing segment over time. In 2016, the European space industry posted sales worth of 8248 Million euro and employed a total of 40.419 workers (excluding other personnel working on site). The six ESA major member states account for 90% of the space industry employment being: France, Germany, Italy, United Kingdom, Spain and Belgium. The Netherlands is ranked number 7 in total industry employment with 965 workers in 2016(ASD Eurospace, 2017a). Space industry employees predominantly male (79%), are higher educated (41% of all workers have a university education of 4-5 years and up) and have a scientific or engineering background.

3.4.2 Public and private customers

Figure 3.2 shows the sales of the European space manufacturing industry per main customer segment over time.

European sales accounts for 77 % of the total sales in 2016, of which 68 % of the total European sales is to public customers. Details of both the public and private procuring entities are shown in Figure 3.3.

Where the public procuring entities can be defined quite detailed, private customers are much more difficult to identify. First, the European public procuring entities will be discussed. In 2016, 59% of the total European industry sales is to the European public institutions where

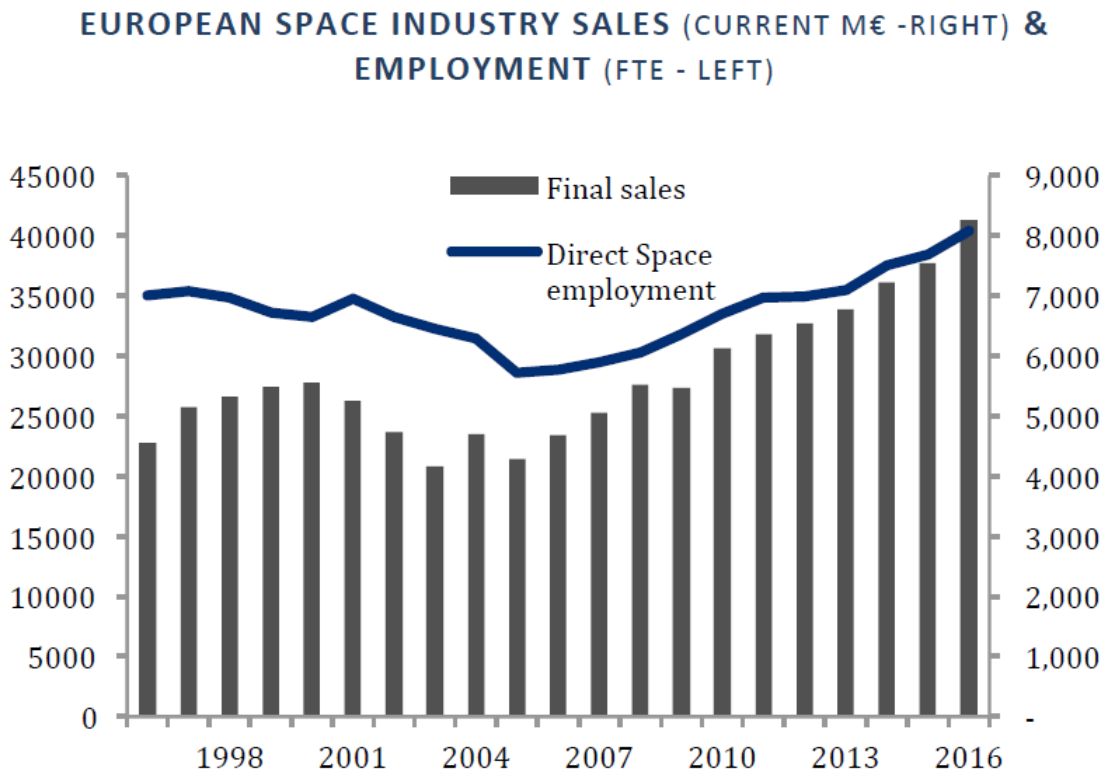

FIGURE 3.1: The European space manufacturing industry sales and employment over time (ASD Eurospace, 2017b)

ESA accounts for 41% of the total industry sales. Within the public segment segment, ESA is responsible for 69% of the sales. It should be noted that the EC delegated the procurement of the Copernicus satellites and the Galileo programme to ESA and that Eumetsat delegated the procurement of its meteorological satellites to ESA. These delegated programmes account for approximately 16% of the total procurement of ESA. The EC procurement can be attributed to the FP7 and H2020 only.

The European private entities that were defined are private satellite operators and Arianespace, leaving out the segmentation of procuring companies in Europe.

3.4.3 Market and product segments

The highest sales to European customers is within the market segment of Earth Observation systems. In the public domain, both ESA and the national space agencies are procuring a high amount of these systems, indicating that earth observation is still a strategic activity for some of the member states. For telecommunications, national space agencies are procuring even more systems than ESA. In contrast, in the market segment of launchers, science and exploration or human space infrastructure, ESA is by far the main client. As a consequence of the privatization of Arianespace and the telecommunications satellite operators, the European private sales

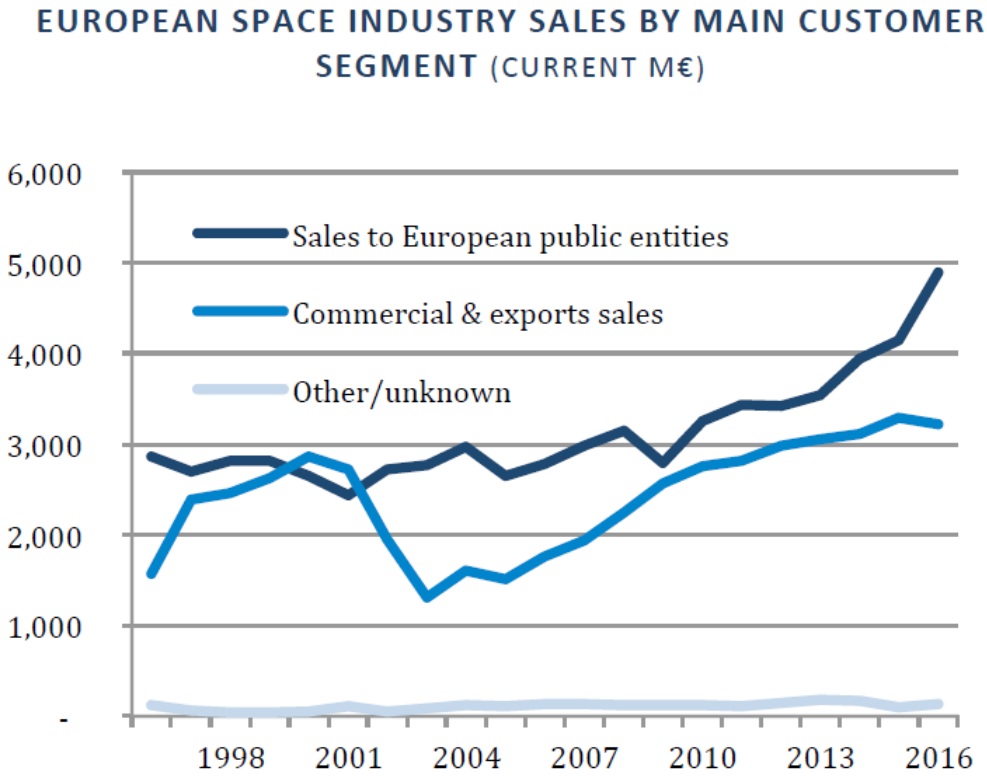

FIGURE 3.2: The European space manufacturing industry sales per main customer segment over time (ASD Eurospace, 2017b)

involves mainly telecommunications systems and launchers. Export sales encompass mostly telecommunications systems (where export sales is even higher than the domestic European sales). The export sales of telecommunication systems is 61% of the total export sales and accounts for 36% of the total European sales on the commercial market.

Next to a segmentation based on market segments, a segmentation based on product segments was also provided. Four main product segments were identified in the Eurospace survey: Launcher systems, satellite applications, scientific systems and ground systems/services. ESA and Arianespace are the main customer of launcher systems, procurement of satellite applications is distributed over various customers with large satellite operators being the main customer and finally, European institutional entities are the main clients for ground systems/services.

3.4.4 Small and medium sized enterprises

In 2017, Eurospace carried out a survey in order to identify SMEs in the space supply chain using the definition provided by the EC(European Commission, 2017f). As new entrants are often SMEs the conclusions of this survey are relevant for this research and therefore listed below(ASD Eurospace, 2017a):

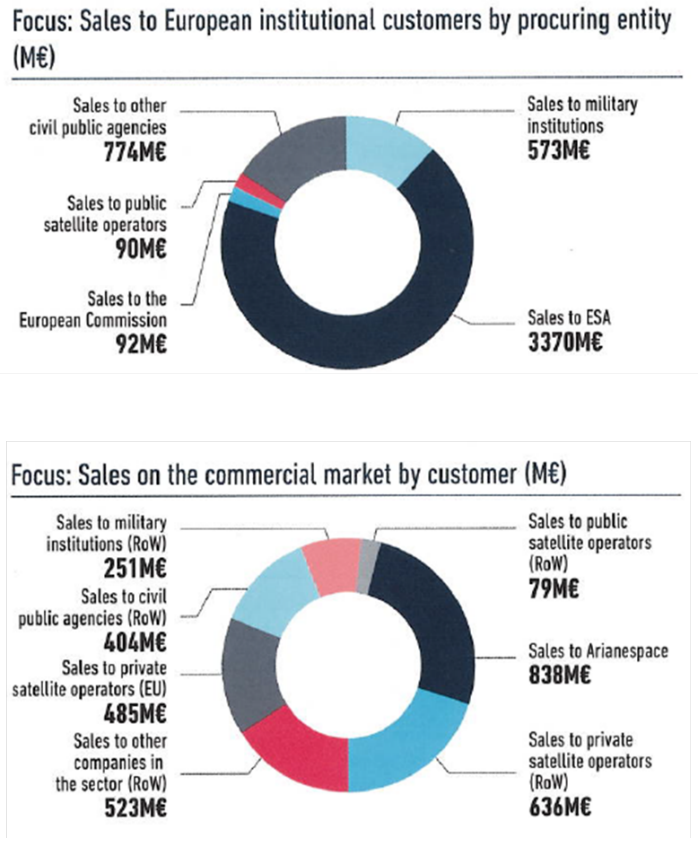

FIGURE 3.3: Details of public and private procuring entities in the European space manufacturing industry in 2016. Commercial market representing European private procuring entities and export sales (being also public entities outside of Europe) (ASD Eurospace, 2017a).

- SMEs only represent less than 10 % of the total space manufacturing employment. Small space units are not uncommon, but they are often part of or owned by a larger company
- 65 companies formally qualified as SME
- Space SMEs may not represent more than 300 M € of the total annual European space sales
- 90% of the SMEs are not pure space players
- The distribution of SMEs is more or less consistent with the importance of the specific space nation as most SMEs are found in France, Germany, Italy, United Kingdom and Belgium
- The 40 largest SMEs are not situated in the major ESA countries but in countries with a rather small space national sector (including the Netherlands with approximately 9 M € mainly in the spacecraft system category). It might be the case that in the main space countries SMEs have been absorbed in larger space groups
- Many SMEs are dependent on only one customer

- There are a large amount of very small SMEs (less than 10 employees)

European SMEs could be categorized in 4 groups based on their capability in the space supply chain: contributor to spacecraft systems, contributor to launcher systems, manufacturing support and contributor to ground segments. Over 75% of the SMEs are either in the spacecraft systems or manufacturing support category. Globally other categories are used, 61% of the space SMEs can be categorized based on their capability in 4 groups: Services to industry, machining/mechanical parts, electric/electronic parts and Electrical/Mechanical Ground Support Equipment (EGSE/MGSE). Eurospace did not elaborate on the relation between the identified European capability categories and the global capability categories. Besides that, the capability categories suggests that those SMEs are part of a supply chain for larger customers and does not take into account that SMEs would be able to supply complete space hardware products. Furthermore, there was no segmentation provided based on customers, nor the market segments of SMEs. When using the space SME database of ESA that lists SMEs working in or being interested in space-related fields (thus not solely the manufacturing industry), 33 Dutch companies are qualified as SME (European Space Agency, 2017g).

3.4.5 Recent trends

Telecommunication system sales are not growing as fast as they did between 2005 and 2010, but still growing. Emerging technology within the telecommunications segment encompasses: high throughput and digital flexible satellites, fully electric propulsion systems and satellite (mega)constellation systems. Eurospace mentions that European players have a strong market position in the satellite constellation segment at both system and equipment level. In the past years, Europe has become a global market leader in earth observation systems. It is expected that export of earth observation systems shall be further supported by national space entities. Finally, NASA has a new procurement strategy that could offer opportunities for export related to ISS servicing.

3.5 New space

As described in Chapter 2, it seems that currently there are many ongoing developments in the private space sector which are not not very well-known. Reasons for that might include that the developments are contemporary and that the space sector is very dynamic. The developments and changes in the private space sector appear to result in the introduction of a range of new players in space activities, hence these new players are often referred to as new space(Paikowsky et al., 2016). However, a formal definition of new space is lacking. Since the focus of this research is market entry in the European private sector, it is of importance to describe the

current trends and developments in the sector. This section will therefore review literature and media publications dedicated to new space.

3.5.1 Defining the concept new space

In literature, the concept of new space or space entrepreneurship is still quite young as it was not until 2006 that Kreisel and Lee started to sketch the commercial space market(Kreisel and Lee, 2008). However the phenomena of space commercialization is much older, the term new space was first used in 1980 referring to companies like Orbital and SpaceHab, being one of the first privately funded space companies (Kreisel and Lee, 2008). In Europe, the concept Space 2.0 is used in a similar context but in general this concept enjoys less popularity(Stefan, 2014). Around the year 2000 the concept of new space revived when internet entrepreneurs started the well known space companies SpaceX and Blue Origin which opened up new space markets. There is not a universal definition of the term new space, but many persons however in the space industry and the political climate use the term to refer to newly founded companies that differentiate themselves from the companies founded during the space race in the time of the cold war. In 2009, the Tauri group performed a research that researched which attributes could be associated to new space and in contrast, which attributes are generally associated with traditional space or "old space". The Tauri Group developed a working definition of new space(Hay et al., 2009): "New Space includes companies that are likely to be flatter, flexible organizations that are consumer focused, innovative, willing to take risks, and focused on new technology solutions." In comparison to new space companies, the Tauri group described traditional space companies as: "more likely to be highly structured and focused on established lines of business, often with the government. They are also more likely to be established in sectors with high value offerings, low sales volume, and low growth."

Furthermore, they found that 13 concepts strongly related to new space companies being(Hay et al., 2009):

- Company culture
  - Young in age
  - Walk before run (first sell parts or sub-systems, then complete systems)
  - Vertical integration
  - Flat organization
  - Privately held
- Technology
  - Technology development focus
  - Novel offerings

- Markets and Offerings
  - Consumer focused
  - Specialized products and Services
  - Service offerings
  - New market creation
  - Uncertain regulatory environment
  - Alternative approach

In contrast, traditional space companies shared six attributes that are not highly represented in new space companies:

- Company Culture
  - Government ownership or investment
  - Large supplier base
  - Hierarchical
- Markets and Offerings
  - Obscure pricing
  - Low sales volume
  - Low growth

Hybrid companies were characterized as companies that integrate both attributes from new and traditional space. The Tauri Group emphasized the dynamic nature of the space sector and pointed out that the definition might not be accurate when using it in a different time period.

Hobbyspace also described the concept of new space and stated that if a company could be related to three or four of the characteristics below, it can be labeled as new space(Hobby space, 2017):

- Low cost focus; New space companies focus on minimizing costs and look for markets with higher user rates in order to achieve economy of scale advantages.
- Incremental Development; Start with minimum viable products in markets that can eventually pay for the development.
- Consumer markets; Aim for mass markets.
- Operations are key; New space companies focus on reliability and reusability rather than technical performance.

- Innovation; Provide innovative products/services for low costs. For example by using new technologies or by using Cheap of the shelf (COTS) technologies.
- Small teams; New space companies tend to avoid large overhead costs and bureaucracy.
- Fixed price only; New space companies usually don't work with the cost plus contracts.
- Humans in space; New space companies often have a higher goal which involves getting a large number of humans in space.

Some of the characteristics of new space proposed by the Tauri group are similar to those of Hobbyspace but the descriptions are more complementary to each other. A clear and exhaustive of description of the concept new space can still not be provided. Therefore, the definitions of new space by some leading space organizations like ESA and NASA were reviewed in order to see if they provide similar definitions to that of the Tauri Group and Hobbyspace. Results are listed below:

- **ESA**; "New Space is generally interpreted to mean the increasing emergence of the private space industry, particularly companies that - when compared to traditional space companies - tend to be less reliant on government support and focused on less well-established lines of business. It is most visible when new entrants to the sector take forward game changing business models that can be either competitive or complementary to existing commercial space services, for example, large constellations of small satellites or companies developing entirely commercial launch systems." ()
- **NASA**; "American private sector individuals and companies investing in space exploration, collectively known as emerging space.()"
- **European Commission**; "Space is now part of a global value chain that increasingly attracts new companies and entrepreneurs, so-called 'New Space', which are pushing the traditional boundaries in the space sector.(European Commission, 2016)."
- **Eurospace**; "So called new space, i.e. the emergence of private actors investing strongly in the space sector(ASD Eurospace, 2017b)."
- **NewSpace Global**; "NewSpace is a global industry of private companies and entrepreneurs who primarily target commercial customers, are backed by risk capital seeking a return, and seek to profit from innovative products or services developed in or for space. Today, the great innovation economy of NewSpace is composed of nearly 1,000 companies worldwide. What was once dominated by few players is today an incredibly diverse ecosystem in terms of company sizes, business models and geographic locations(NewSpace Global, 2017)."

- **Space Frontier Foundation**; "New space is people, businesses and organizations working to open the space frontier to human settlement through economic development(Space Frontier Foundation, 2017)."

Most of these mentions of the term new space were in media publications from the organizations in question and were therefore hard to find. No official working definitions of the term new space was found for these organizations with an exception for NewSpace Global (NSG), a new space analyst firm founded in 2011, and Hobbyspace. Recent scholars also describe the concept of new space. E.g. Paikowsky et all (2014) mentions the introduction of a range of new players, most of them private, offering different business models bringing innovation to the space sector(Paikowsky et al., 2016), Cornell et all (2011) described new space as small companies with a young workforce capable of out of the box thinking which made them competitive to the large incumbents. The emergence of new space brings a large number of new entrants into the space industry and with them new challenges and ambitions for the space industry. The new space companies disrupted traditional business models which resulted primarily in overall cost reduction of space technology (Cornell, 2011).

A lot of media publications can be found when searching for "new space". Forbes for instance writes that "People may not know exactly what NewSpace is" and they emphasize that the spotlight is on low-cost and visionary commercial space technologies but that the concept new space "is more than that"(Forbes, 2016). The Observer Research Foundation (ORF) also writes that there is no "internationally accepted technical definition of NewSpace". ORF points out that "the ethos of the movement has been to challenge the traditional ways of space exploration that are widely considered as too expensive, time-consuming, and lacking in room for inventive risk-taking"(Observer Research Foundation, 2017).

The above descriptions of the space organizations, media publications and scholars emphasize the private investment and the innovative nature of new space companies. Furthermore, some mention the focus on cost reduction but in general the above descriptions are consistent with, but less detailed than the working definition provided by the Tauri group.

3.5.2 Underlying reasons for private space sector growth

The emergence of new space happened around the year 2000. This is not related to withdrawal of public entities from the industry, on the contrary, in 2015, they were still responsible for 57% of the total procurement in the manufacturing segment(ASD Eurospace, 2016b). The emergence can be explained by the increased demand for services based on space technology like telecommunications and navigation(ASD Eurospace, 2016a). Eurospace, the trade association of the European Space Industry, states that the public sector drove the transitioning of the space sector by providing more flexibility within the implementation of space programmes and providing assurance by offering long-term commitment to user services(ASD Eurospace, 2016a).

Space Ventures Investors (SVI) is a company founded in 2009 dedicated to investing in new space companies. They mention that Europe is seeing a massive growth in new space companies because of the following reasons(Space Ventures Investors, 2017):

- Increased intellectual human capital because there are more students graduating from high-tech universities and there is an increased availability in the EU of managers with lots of experience in high-tech business.
- Government incentives for fostering entrepreneurship
- The cost of space technology in general is decreasing.
- Better understanding of the financing structures in the space value chain.

Multiple sources stated that the number of new entrants in the space industry have increased, however do not mention how many new entrants there are, nor in which segment of the space industry they are active(ASD Eurospace, 2016a; Cornell, 2011; European Commission, 2016). New Space Global was founded in 2011 and at that time analyzed approximately 125 companies while they are currently tracking nearly 1,000 companies(NewSpace Global, 2017). The number of companies tracked by New Space Global is the only data found that gives somewhat of an indication of the growth of the New Space industry. However, it is unclear in which countries these newly founded companies are based and in which level of the space value chain they operate. Low-cost access to space is identified as "a key enabler" and "catalyst" for new space by G. Sadlier from London Economics(Sadlier, 2014).

3.5.3 New space markets

The descriptions and definitions of the concept new space, do not define in which markets new space companies operate, only that they open up new markets, are innovative and are likely to trigger cost reduction. However, both NSG and SVI describe specific markets that they relate to the new space sector. Very limited information is publicly available as these market insights are very valuable.

According to SVI, five main market segments can be identified in the new space sector:

- Satellites
- Rockets and delivery systems
- Space debris
- Space tourism
- Asteroid mining and space resources

They state that although the satellite market and the market for rockets and delivery systems is already many years in operation and funded by the government, there is much room for commercial applications (e.g. by miniaturization or cost reduction). Space debris is a new market that is expected to grow in line with the growing space activity as legislation might require debris removal from space. Therefore government funding on space debris initiatives might be possible. Space tourism is a market that is estimated to develop in the near future where at first this will only be available for wealthy customers. SVI expects that this market will be strictly commercial and government funding will not be available. There are already companies active in the market of asteroid mining, the mining of precious resources like water or energy in space. This market is expected to further develop in the coming decade. It is uncertain if there will be government funding for asteroid mining initiatives. SVI states that companies active in these new space markets are predominantly privately funded (Space Ventures Investors, 2015). SVI mentions multiple drivers for the growth of commercial space among which: Geopolitical conflicts and extreme weather as this will increase the need for surveillance and monitoring assets (Space Ventures Investors, 2015). SVI states that global internet coverage, alternative propulsion (e.g. plasma rockets and fusion energy), mars missions, space habitation, human space transport, space based agriculture and space elevators (access to space without rockets) are other themes of interest for the new space sector (Space Ventures Investors, 2015).

NSG also describes new space markets and their main players by means of defining 8 verticals of the new space market which are shown in Figure 3.4. Vertical markets are markets that have a very specific type of customers in contrast to horizontal markets that are able to serve various customer segments.

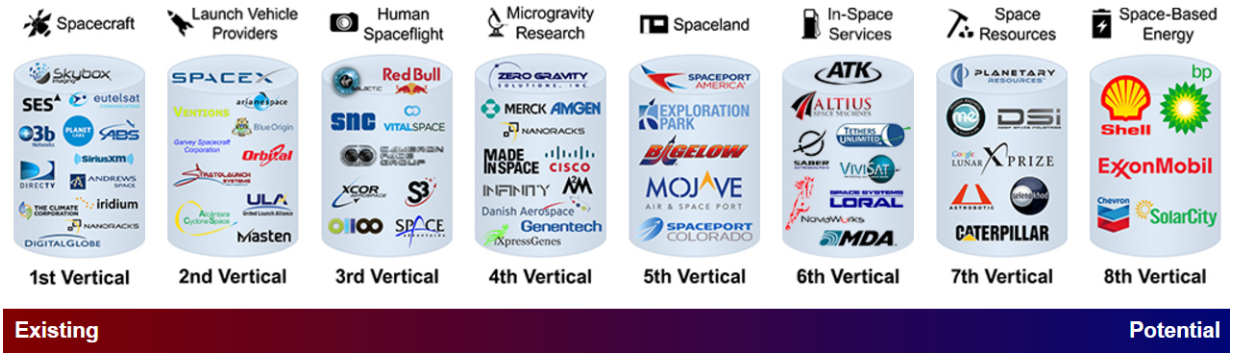

FIGURE 3.4: The eight verticals of new space according to NSG(NewSpace Global, 2015)

3.5.4 The number of new entrants

The growth of the space sector is reflected in the growth of sales in the European space sector as presented in Section 3.4. However, the amount of new private entrants is unknown. From data provided by the NSG and the Tauri Group, a rough estimation can be made.

When NSG was founded in 2011, it tracked 125 private space companies and entrepreneurs while it currently tracks almost 1000 new space companies. The CEO of NSG stated that he predicts that there will ten thousand new space companies created in the next ten years(Pendle, 2017).

The Tauri Group analyzed data of publicly reported private financing of space ventures over the period 2000 through 2015 worldwide, generally excluding government funding with exception of certain grants. The Tauri group defined start-up space ventures as space companies that began as angel- and venture capital-backed start-ups (The Tauri Group, 2016). The start-ups can be either manufacturers or service providers.

In total there started over 80 angel- and venture-backed space companies in the research period. In the early 2000s, an average of three space companies were started per year while in the past five years, this number was an average of eight companies per year. The number of investors also grew to an average of 55 per year in 2015 while this was 7 in the period 2000 through 2005 indicating increased interest in commercial space.

3.5.5 Investors and investment in new space companies

In general, two types of investors can be distinguished; public and private investors. Public investors generally fund the early phase like R&D and then private investors are needed for the commercialization and post-commercialization phase were venture capital is needed.

The Tauri Group researched the background of new space investors and identified over 250 investors, of which 66 % is based in the USA while the other 34% is distributed over 25 countries. Space ventures have in total attracted $13.3 billion of investment. Figure 3.5 gives insight in the different forms of investment applicable for (new) space start-ups. Venture capital (VC) is with a total investment of $2.9 billion of which 80% in the last five year the most prominent investment instrument (not including debt financing as an investment instrument).

VC and angel investors together represent two third of the 250 in total defined investors as can be seen in Figure 3.6.

Although investment in space companies seem to have grown significantly, Sadlier states that there is a finance gap for space companies. In Figure 3.7 he relates the different facets of investing in new space to obstacles which eventually are thought to result in a finance gap(Sadlier, 2014). Sadlier states that there is a lack of knowledge on how to successfully invest in new space companies. Furthermore, Sadlier argues that there is no appetite to invest as the return on investment time is very long. And finally, new space requires a lot of investment and there is currently not enough capacity for this investment.

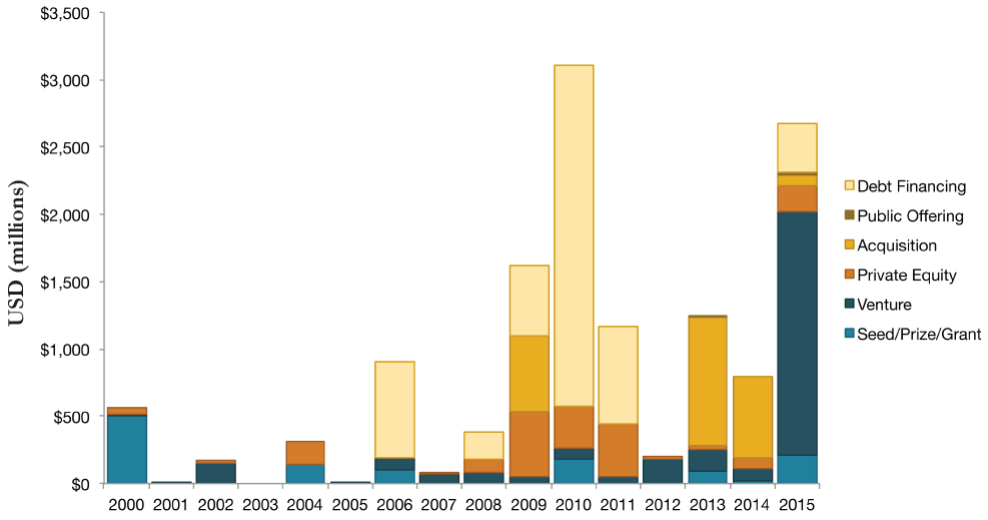

FIGURE 3.5: The mix of types of investment in space companies varies over 2000 to 2015. Image from (The Tauri Group, 2016)

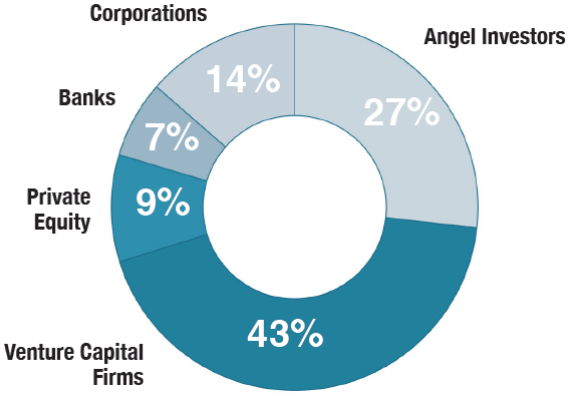

FIGURE 3.6: By number of investors, VCs are the largest investor group for space start-ups. Image from (The Tauri Group, 2016)

3.6 The policy framework

The EC, ESA and national space agencies all have their own vision and goals regarding space policy. Some specific topics are jointly coordinated as described in the European space strategy(European Space Agency, 2017d). All these governmental bodies underpin the importance of the presence of SMEs in the space sector. This Section will review the main policy instruments able to facilitate successful market entry in the space manufacturing sector. The national body of interest for this research is the Dutch space office (NSO). Policy instruments are defined as being "techniques or means through which states attempt to attain their goals"(Linder and Peters, 1990).

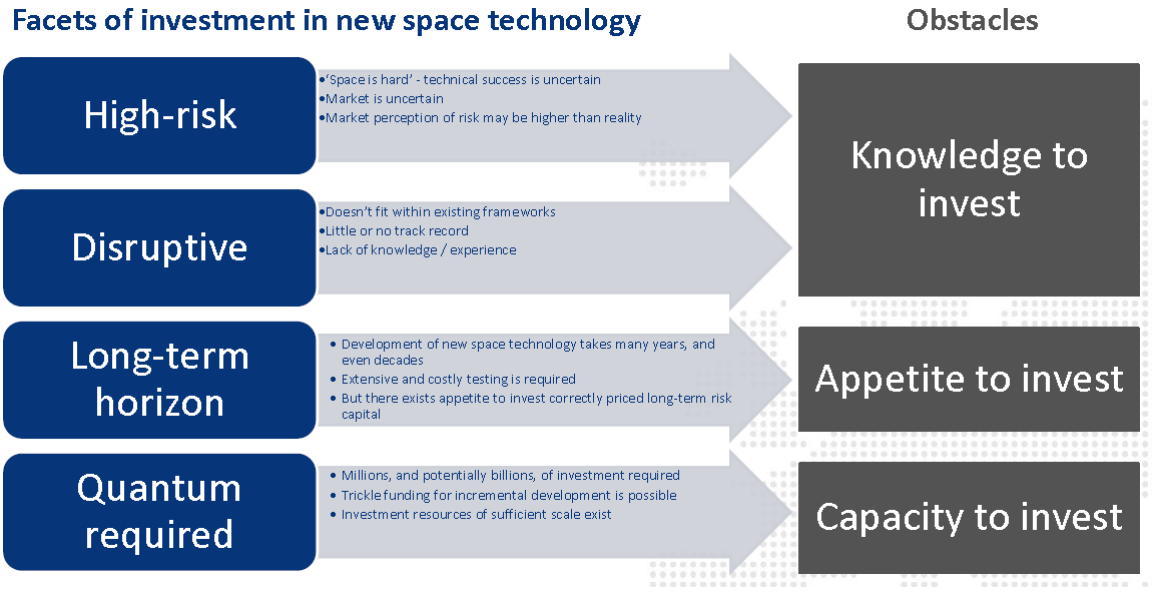

FIGURE 3.7: The finance gap explained by the different facets of investing in new space. Image from (Sadlier, 2014)

3.6.1 The European Commission

The policy instruments currently in place that are able to promote and facilitate the successful market entry of space manufacturing SMEs identified by literature review are:

- Horizon 2020
- COSME
- The European Structural Investment Fund (ESIF)

Horizon 2020 is the EU Research and Innovation funding programme for the time period 2014-2020 (the successor of the 2007-2013 Seventh Framework Programme (FP7)) . Horizon 2020 funding is applicable for space companies in their R&D phase in order to stimulate the development of innovative space technologies and for companies aiming to develop applications based on space data(European Commission, 2017b). The EU programme for the Competitiveness of Enterprises and SMEs (COSME) is also running from 2014-2020. COSME aims to promote access to finance in the complete life cycle of the SME by providing guarantees to financial institutions so that SMEs will be able to get a (higher) loan and by providing risk capital in funds investing in the later stage of SMEs. Furthermore, COSME promotes access to markets by funding organizations like Enterprise Europe Network and the Intellectual Property Rights (IPR) SME Helpdesks that support and advice SMEs. Finally, COSME also encourages entrepreneurship and stimulates better framework conditions for competitiveness in multiple ways(European Commission, 2017a). The third instrument of the EC is the ESIF that is able

to fund SMEs in close to market and first production activities if they are working on the defined industrial priorities which could include space technology (European Commission, 2017c).

In 2016, the EC published their updated European space strategy. Their main strategic goals are(European Commission, 2016):

- Maximizing the benefits of space for society and the EU economy
- Fostering a globally competitive and innovative European space sector
- Reinforcing Europe's autonomy in accessing and using space in secure and safe environment
- Strengthening Europe's role as a global actor and promoting international cooperation

These strategic goals could result in the implementation of more policy instruments able to promote and facilitate the successful market entry of space manufacturing SMEs. Specific policy instruments are not yet developed, but some general examples or basic outlines of potential policy instruments were presented including (not exhaustive)(European Commission, 2016):

- Explore alternative business models like public-public, public-private partnerships or buying services
- Support specific long term R&D needs like like low-cost and alternative access to space and in-orbit servicing
- Facilitate the use of intellectual property rights to stimulate innovation
- Pre-commercial and public procurement of innovative solutions
- The 'first-client' approach for space start-ups
- Establishing space hubs that bring together the space, digital and user sectors.
- Enhancing the use of prizes and competitions

3.6.2 The European Space Agency

The ESA has many instruments which have a special policy or are specifically designed for SMEs that want to do business with ESA. The following instruments were identified by literature review(European Space Agency, 2017f):

- Technology Transfer Programme (TTP) inlcuding Business Incubation Centres (BICs) and technology broker network
- The SME Office

- Invitations to tender (EMITS)
- Training courses for SME
- ESA programmes open for SMEs:
  - Procurement actions reserved for SMEs and "Non-Primes"
  - Technology Research Programme (TRP) with 100% contracts
  - General Support Technology Programme (GSTP) competitively general on a 100% funding basis
  - Core Technology Programme (CTP) on a 100 % funding basis and sometimes SMEs are favoured as subcontractors to primes
  - The General Studies Programme (GSP) funds studies that gather knowledge in different areas and encourages small companies to participate
  - Advanced Research in Telecommunications Systems (ARTES) and in specific the ARTES Entry initiative and IAP Kick-Start that can fund up to 75% of the feasibility studies or R&D activities of companies that want to enter the field of satellite communications
  - NAVISP which is funding of satnav technology and innovation research programme (up to 80% funding for SMEs)
  - PRODEX (PROgramme de Dveloppement d'Expriences scientifiques) offers contracts to institutions and industry to work on ESA experiments

The TTP intends to unlock applications of space technology in non-space markets in order to create demand for space technology in non-space markets. New customer demands could lead to profitable business opportunities which stimulate entrepreneurship in the space industry. ESA has therefor a large network of business incubators that support new ventures, which have their core business directed at using space technology in non-space applications, in the early phase(European Space Agency, 2017a). The SME office of ESA aims to facilitate the involvement of SMEs in the R&D activities of ESA by raising awareness of SME capabilities by for instance managing an SME database or by organizing events like the Industry Space Days (ISD)(European Space Agency, 2017e). ESA has invitations to tender that are also open for SMEs and sometimes specifically directed at SMEs. Furthermore, ESA offers training courses for SMEs and ESA has a lot of programmes that are also open for SMEs. Many of these programmes offer a 100% funding of the R&D activities of SMEs.

ESA maintains a geographical distribution or fair return meaning that the financial contribution of the member states determines the return for the industry of the specific member state in terms of ESA contracts(European Space Agency, 2017c). The Netherlands is number 8 of the contributors in the obligatory space programmes because the contribution is based on BNP, and

the Dutch BNP is relatively high. However in the optional space programme contribution, the Netherlands is ranked number 13(NSO, 2016). The Netherlands has an over return of their ESA contribution since ESTEC is located in the Netherlands meaning that it is relatively difficult for Dutch companies to get ESA contracts.

3.6.3 The Dutch Space Office

The national programme of the NSO encompasses financial instruments, non-financial instruments and national projects in order to realize the Dutch space policy. Furthermore, regional grants and general financial instruments for innovation are also available in the Netherlands but those will not be explained in detail in this research. The Netherlands does not have a national space programme. From literature review the following instruments that could be of interest to space manufacturing SMEs were identified(NSO, 2016, 2017; RVO, 2015):

- National projects like TROPOMI, OMI and Sciamachy which can offer ad-hoc funding
- Funding programmes
  - Small Business Innovation and Research (SBIR) which is a grant for the early phase
  - Partnerships for Space Instruments & Applications Preparatory Programme (PIPP) which is a grant to cover the cost of scientific personnel
  - User Support Programme for Space Research that covers the cost of 1 phD or postdoc worker
  - Geodata for Agriculture and Water (G4AW) which is a grant programme
- Satellietdataportaal is a portal that offers free high quality satellite data of the Dutch territory
- WBSO/RDA and innovatiebox which are fiscal policies for R&D activities
- General financial instruments to stimulate innovation

The NSO uses technology roadmaps to articulate their long term vision and to review grant applications. Until 2010 prekwalificatie ESA-programma's (PEP) existed which was a grant programme focusing on getting companies ready to participate in ESA programmes.

3.7 Entry barriers in the space industry

Barriers for market entry vary across industries and describe the conditions that hamper a business from entering a certain market(Lofstrom et al., 2014). Many entry barriers have been identified for the commercial European space industry and some will be discussed in this Section.

It is impossible to discuss all potential entry barriers for the space industry. This research aims to identify the most important entry barriers currently encountered by new entrants in the commercial European space industry.

Space technology is highly complex technology which is often used for the purpose of defence. Due to those characteristics, space technology projects are often costly, large scale and under leadership or supervision of the government or under leadership of large multinational companies. Space technology is also often subject of heavy export control since many components are classified as dual-use, products that could have both civil and military applications(Leloglu and Kocaoglan, 2008). The development time for new space technology is typically very long and high investments are required that are associated with a high level of risk while the pay-back time is very long. Due to high quality and safety regulations there are many prime contractors, which do not provide many opportunities for new entrants. Due to the extensive regulations, technologies cannot be changed easily thus a chosen technology needs to remain competitive during its entire lifetime. Furthermore, the high degree of vertical integration also does not leave much room for new entrants. And finally, venture capital in Europe is not as focused on financing start-ups and business angels are less common in Europe.

3.8 Conclusion

Important take-aways from this Chapter will be presented in this Section. First of all from the description of the context of the space industry we can see that the space industry is at the point of an industrial revolution. This is because the space industry evolved from the cold war and therefore always experienced a high degree of government control which is now loosening and the commercial sector is growing (3.2.1). This is something that the space industry has not experienced before. The commercial sector brings many new applications of space technology and brings in new customers. Space technology currently offers many business opportunities which do not go unnoticed. Multiple billionaires investors became interested in space which accelerated the development of the the commercial space sector. History shows that Europe is more of a follower in the space industry than a pioneer. ESA was founded much later and ESA can still not perform crewed launches on its own (3.2.2). Europe again needs to follow the new space trends otherwise it will sidelined which could lead to serious safety, economical and political consequences. Europe needs to fight for its position in the global space industry as we see that Europe at the moment does not has a fully independent space sector (3.2.3). The space value chain was discussed in Section 3.3, there we see that the classical space value chain distinguishes clearly manufacturers, launch operators, space operators and service providers. When analyzing some examples of new space companies, it can be seen that they are not clearly positioned in one of the levels of space value chain. It can thus be concluded that it is unknown in which level of the value chain new entrants are positioning themselves and even

if they can be classified in the current levels. This study decided to focus on companies that produce space hardware since this is the most difficult segment to enter and without upstream hardware, downstream services can not exist. We see that the manufacturing segment has grown substantially the last 10 years, both sales to public and private entities. These are general figures of the industry but for this study we are interested in what new space companies do. First of all, it is very hard to define new space. Even the leading organizations in space like NASA struggle with a definition and use multiple terms interchangeably (e.g. emerging space, space 2.0, new space). The Tauri group provided a working definition as a result of their analysis of new space companies. However, it is unclear what companies were included in this studies e.g. what companies classified as a new space company. Furthermore, the research is from 2009 which is a long time ago when taking into account the dynamic nature of the commercial space industry. The definition therefore might be outdated. Therefore, it will be used in this research but it will be taken into account that the definition might need some refining, so no direct conclusions will be drawn from it. Hobby space also provided a definition of new space which seems to be complementary to that of the Tauri Group. Hobby space outlines multiple facets that can be related to new space. This description of new space provided by Hobby space is useful for analyzing business models as it point out specific elements that characterize new space companies. In addition to the difficult definition of new space, it is very hard to define in which markets the new space companies are active. A reason for this might be the that this information is very valuable as it can be used by investors. It can be noticed that there are some companies who claim to have this data and are also selling it. Organizations like ESA and NASA do not seem to provide an overview on their websites or in their media publications. So not only is it unknown in literature how to define a new space company, is is furthermore unclear how new space companies position themselves in the value chain but it is also unclear in what markets they operate. The only thing that is known is that new space companies are generally backed by venture capital investors and that most of these investors are based in the US. This information supports the feeling that it is difficult for Europe to keep up with the new space developments in the US.

Chapter 4

Literature review

This Chapter will provide further background information on the concepts of interest mentioned in Chapter 2 (Introduction).

The first topic to be considered will be that of innovation. Innovation is not identified as a variable in this study. However, in the problem definition it is argued that new entrants are likely to bring disruptive innovation in a certain industry. As this is one of the main arguments for the relevance of this study, the concept of innovation will be introduced here and disruptive innovation will be defined. Subsequently, argumentation for why new entrants are preeminently suitable to trigger disruptive innovation will be provided in the Section about Innovation. Subsequently, literature on the independent variables business models and market entry strategy will be reviewed. The policy framework and market entry barriers are topics that are already covered in Chapter 3.

4.1 Innovation

A review on the definition of innovation and different innovation types will be presented in this Section.

Schumpeter was one of the first scholars that defined innovation: innovation implies bringing something new into use(Schumpeter, 2003). There are still debates on the best definition. Usually, two types of innovation can be distinguished based on the results that the innovation process creates; Incremental and radical innovation(Ettlie et al., 1984) or sustaining and disruptive innovation(Bower and Christensen, 1995; Christensen and Clayton, 1997; Christensen et al., 2003). Ettlie et al characterized incremental innovation by minor changes that aim to optimize of the product or service in question while preserving the underlying concept. In contrary, radical innovation was characterized by changes that alter the underlying concept causing new markets and new applications to be discovered. Christensen distinguishes sustaining innovation from disruptive innovation not by the nature of the changes but by the value proposition

that the new product brings to the market. He characterized sustaining innovation as an improved product performance which mainstream customers in major markets have historically valued. The improved product performance can be achieved by either incremental or radical changes. Disruptive innovation is characterized by changes in the product of service that result in new value propositions. New value propositions do not necessarily need to outperform existing solution in the case of disruption, in fact it often under performs when compared to market standards. The strength of a disruptive innovation is embedded in the fact they attract new customers by offering new features designed for a new group of customers, or offer more convenience or lower prices to customers that will appeal other market segments of the existing market(Christensen et al., 2003).

Literature on (disruptive) innovation in the space sector is relatively absent but one research was found that mentioned the ESA Advanced Concepts Team (ACT) which is also focused on creating disruptive innovation in the space industry(Summerer, 2012). The ACT is not focusing on new entrants in the European commercial space industry and is therefore considered to be out of scope for this particular research. Summerer mentioned the following characteristics of the space industry as potential reasons for the relative absence of innovation literature in the context of the space industry: The space industry is characterized by a high level of governmental control which influences market dynamics and limits market-driven innovation, the space industry is small and there is a very limited amount of easily accessible data.

4.1.1 The innovator's dilemma

Now it can be explained that new entrants are more likely to bring disruptive innovations to the market than incumbents. Incumbents tend to stay close to the needs that their customers express. Incumbents do recognize new technologies but fail to bring them to the market as they perceive it as a bad investment decision since existing customers give negative feedback on the ideas. Entrepreneurship is a broad concept with many definitions. In the EC policy documents, entrepreneurship refers to starting a new venture(World Economic Forum, 2014). Fostering entrepreneurship, as intended by the EC, will thus result in an increased amount of new commercial entities in the European space industry and therefore an increased likelihood of disruptive innovation in the space market.

4.2 Business models

For the purpose of this study, the concept of business model needs to be able to provide a description of the business model and to be able to compare the business logic of a company in a clear and structured way. In order to select the right business model definition and framework for the purpose of this study, first the origin of business models in general will be discussed.

Subsequently multiple frameworks will be discussed and finally one of those frameworks will be selected. Then, an overview of the use of the concept business model in the space industry will be presented. Finally, critics on business models will be discussed leading to argumentation for the conceptual model of this study.

4.2.1 Origin and definition of business models

The term business model is relatively young, it was not until the 1990s that it actually became popular and was then often used in relationship to the internet (Osterwalder et al., 2005). Also other technology related companies picked up on the concept of business models. Currently, more industries are using the concept business model. At the moment, literature has not yet agreed on the definition and structure of a basic business model and there is no consensus about the purpose of business models (Osterwalder et al., 2005; Morris et al., 2005; Zott et al., 2011).

The concept of business model is used interchangeably for different definitions (Linder and Cantrell, 2000). Examples include, components of business models, concepts of business models, types of business models referring to real companies (e.g. the Apple business model). Osterwalder et al classified the different writings about business models and argues that when using the concept of business models a clear definition must be presented. Osterwalder et al also states that the role of the concept business within firm is still not uniformly accepted. The term strategy and business model is often used interchangeably (Magretta and School, 2002). Magretta makes a distinction between strategy and business model by stating that strategy also includes competitive advantages. However, Seddon et al has a different view, they state that a business model is solely the abstraction of the strategy (Seddon et al., 2004). Osterwalder et al states that most of the business model literature refers to business model as the logic of the company, a model for how all elements fit together and eventually are able to add and market value. The term business model is thus ambiguous. Several articles aimed to create consensus about the business model concept (Morris et al., 2005; Zott et al., 2011; Osterwalder et al., 2005).

Osterwalder et al proposes the following definition for a business model: "A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams." This definition will be used in this research. The aim of a business model in this research is thus to describe the aspects that will finally explain how the business will be able to make profits.

4.2.2 Business model frameworks

Multiple business model tools are available like the lean canvas, fluidminds, the business model canvas, the value model and many more. For the purpose of this research, the business model framework of Osterwalder et al seems to be the best fit as it is practice oriented, simple and useful for comparing and mapping business models(Spanz, 2012). The framework is named the business model canvas and consists of nine building blocks that together should comprise the complete business model(Osterwalder et al., 2005):

1. Customer segments
2. Value propositions
3. Channels
4. Customer relationships
5. Revenue streams
6. Value configuration
7. Core competencies
8. Key partnerships
9. Cost structure

4.2.3 Critics on the business model canvas

The business model canvas is a widely used tool but also a widely criticized tool. This Section will discuss the limitations of the business model canvas. Coes studied the limitations of the business model canvas and concluded that there are four main limitations of the business model canvas(Coes, 2014):

- External forces are not included in the model (e.g. competition)
- The narrowness of the value proposition
- The abstraction level is not equal in all the nine building blocks
- The relation between the individual building blocks is not included

Coes argues that factors like competition and market environment are of huge influence when trying to research the way how a business will be able to make profits. The narrowness of the value proposition was mentioned because it only focuses on making revenue in terms of

money so the framework can't be used for other organizations like the government or non-profit organizations. The different building blocks don't have the same level of abstraction. For instance key activities or key resources are blocks on a lower level of abstraction while customer segments is a building block with a high level of abstraction. Finally Coes mentions that the interrelations of the building blocks is often not considered and emphasizes the relevance of making a story out of the business model canvas.

Many other papers discuss the critics on business models(Kraaijenbrink, 2012; Maurya, 2010; King, 2010; Hong et al., 2014; Upward, 2013). Additional limitations of the framework encompass that it does not include strategic purpose, does not take into account KPIs and performance measurement and is too static.

4.2.4 Related concepts

A study by Coes describes the relations of the concept business model with other concepts and considers the following to be most important: Value, strategy, organizational alignment, resources and activities, cost and revenue streams and innovation(Coes, 2014). For this study, especially innovation and strategy are of interest since the intended goal of new entrants in the space market is innovation.

More research is available on the relation between business models and other concepts but there is almost no research available on the relationship between business models and choice of entry mode(Ojala and Tyrväinen, 2006). Ojala et al mention that this finding is most surprising since many studies suggest that there is a connection between the entry mode selection and the nature of a firms business, the characteristics of a product, requirements for customer support and customiziation needs (Ojala and Tyrväinen, 2006). Therefore Ojala et al investigated the relation between business model and entry mode in software firms and found the product strategy and the service and implementation model are closely connected to the entry mode (Ojala and Tyrväinen, 2006). Trimi et al even states that business models can be used to describe and forecast entrepreneurial outcomes (Trimi and Berbegal-Mirabent, 2012).

Ojala et al did not mention any entry barriers. However, it is widely known that the space market is considered to be a market suffering from high entry barriers. Furthermore, one of the most well known characteristics of the space market is that the government control is very high. This study therefore hypothesizes that the choice of market entry strategy and business model is related to successful market entry.

4.2.5 Business models in the space industry

As mentioned before, there is not a single definition of a business model in literature. Therefore, the general logic of business models in the space industry found in literature will be discussed

here instead of providing a thorough analysis consisting of the nine building blocks. Grimard et al states that six different forms of business models can be found in the space industry(Grimard, 2012). The work by Grimard however describes six different forms of public private partnerships (PPP's). Therefore, a PPP is mentioned here as one type of business model. Other business models that rely less on the government as a direct stakeholder that are described in literature include the vertical integrated model and the hybrid model. All these models will be discussed in the following Sections.

4.2.5.1 Public Private Partnerships

PPP's are common in the space industry as there is still strong government involvement in the space industry. Six different forms were described by Grimard et al.

- The classical institutional business model: Programs that have a strategic or political aim and no commercial applications (e.g. space science, military application) can apply the institutional business model. In these situations, governments provide the resources to either the local space agency or the Ministry of Defence (MoD) that can in turn procure space systems from the space manufacturers. The government has full control over the programme as it operates the procured space system and delivers the services directly to the end users, which are in this case either the science community or the armed forces.

- Government owned, company operated (GOCO): The difference with this model and the institutional model is that the government does not operate the system which it procured. This situation emerges when there are commercial applications besides the intended public applications of the government. Via a concession, a convention of use or via a licensing scheme, the government allows an operator to operate the system and to sell the commercial services. Examples in Europe include the operations of the Ariane family by Arianespace and of the SPOT satellites by Spot image.

- The concession model: This model can emerge when the government has a need for a certain service but is not able to make the investment to procure the infrastructure itself. A long term concession contract can be offered to a private operator so that it becomes an attractive business opportunity and private funding can be raised. As an example, the UK MoD has a long term contract for procuring secure communications with Paradigm Secure Communications (PSC).

- The co-ownership model: This is applicable in cases where the system is able to serve both the needs of the commercial market and the public needs. The public and private partners invest, own and operate the space system together. The investment of the private partner is usually related to the expected returns that will come from the commercial market. The public partner could in turn get some return on the investment through fees from

the commercial earnings. Terra SAR-X is an example of a co-ownership. The German space agency (DLR) an Astrium (the commercial party) jointly funded the Earth radar observation Terra SAR-X. DLR uses the services for scientific purposes while Astrium uses the Geo-information for profit purposes.

4.2.5.2 A mature private business

Grimard et al identifies a mature private business as a business model as well. Operators providing telecommunications were mentioned as an example as they all have been acquired by equity funds in the past several years. They are completely self-sufficient due to revenues coming from the stable telecommunications market where there are many long term contracts between operators and service providers.

4.2.5.3 A pure value added services model

Grimard et al uses the navigation services as an example to describe the pure value added services model. The GPS system was funded by the US government for military purposes. Subsequently, the civil signal was offered for free worldwide. This resulted in the creation of a wide variety of commercial companies that offer navigation services as they are not limited by a large investment.

4.2.5.4 Vertical integration

Literature describes the business models of large multinational actors in the space manufacturing industry as characterized by a high degree of vertical integration which means that they are able to design and manufacture most of the equipment themselves. This strategy helps to save costs(Kappler, 2000).

4.2.5.5 Hybrid model concept

Schmidt proposed a concept business model for start-up companies which allows them to enter and survive in the commercial space market(Stefan, 2014). According to Schmidt, a hybrid business model would refer to a company that serves both the public and the private market. The advantage of this business model is that the company in question would be independent from political strategies but would also be able to fall back on the public market when the private market experiences economic downturn. In a situation where the private market is experiencing economic growth, there are many opportunities for the company in the private market and the tax revenues of public entities are increased as well. Therefore, when the economy is on the downturn again, the public budgets will be sufficient in order to provide opportunities in the public market. The hybrid business model concept therefore includes multiple business models

in which a company can shift depending on the state of the economy. Furthermore, the hybrid business model is a strategy to avoid geo-return limitations imposed by the public market. The concept of the hybrid business model is not new as there are already many examples of established companies that diversified there offerings to both the public and private market (a.o. Airbus, Thales). However the concept developed by Schmidt is new in the sense that the hybrid model should be built-in from the moment of the business foundation. A hybrid business model is thought to provoke new market discovery and the development of intersectional innovations.

4.2.5.6 Business model innovation

As was mentioned in Chapter 2 business model innovation was mentioned as a predictor for 'operating successfully in the space industry'(Vecchi and Brennan, 2015). Vecchi et al approached business models in a different way than is done in this research and analyzed three new space companies on business model innovation: Virgin Galactic, Mars One and Axe/Lynx Apollo. Vecchi et al use the concept of business model as provided by Zott en al: 'a system of interdependent activities that transcends the focal firm and spans its boundaries'(Zott and Amit, 2010). Zott et all define three design elements of business models: content, structure and governance. Content refers to the selection of activities that are performed by the company, structure describes how the activities are linked and governance refers to who performs the activities. Vecchi et al claim that the space companies they have investigated were able to operate successfully in the space industry by relying on business model innovating which they accomplished by leveraging these design elements. This is a different approach to researching the business models of space companies but it can be concluded that content, structure and governance are important factors to consider when researching business models of space start-ups.

4.3 Market entry strategy

This Section will discuss the difference between the concepts market entry and market entry strategy. Finally, literature discussing market entry (strategies) in the space industry will be reviewed in this Section.

4.3.1 Market entry strategy

In this research, market entry refers to "initial production of a product or provision of a service" (Helfat and Lieberman, 2002). When researching the concept market entry, it is most often associated with international expansion of an existing (multinational) firm(Buckley and Casson, 1998; Zahra et al., 2000; Agarwal and Ramaswami, 1992). An entrant could refer to an existing company which is diversifying, to a parent-company venture (joint venture, franchise or parent spin-off) or to a de novo entrant (start-up or entrepreneurial spin-off)(Helfat and

Lieberman, 2002). As stated before, these definitions of entrants are often used in relation to internationalization theories. However, this research focuses on de novo entrants in a domestic market.

Market entry is often said to have three components: entry location (EL) (which markets to enter), entry timing (ET) (when to enter) and entry mode (EM) (how to enter) sometimes called the ELETEM decisions(Preece et al., 2016). The aim of this research is to describe the overall market entry strategy and not one specific ELETEM element as there are not much prior studies on this topic. Therefore, this study will use the concept market entry strategy instead of the concept market entry. Leih and Teece provide the following the definition of market entry strategy (Leih and Teece, 2014): "Market entry strategies refer to a companies goals, plans and decisions in regard to which market to enter, when to enter, and how to enter (taking into account opportunities, threats, and customer needs). Market in this case may refer to a market segment, domestic, or international."

Although market entry strategy is a broad concept, often these strategies are categorized. Hill et all for example mention the following market entry strategy categories: turnkey projects, licensing, franchising, joint ventures and wholly owned subsidiaries(Hill, 2013). Other market entry strategies that were identified include: acquisitions, strategic alliance, greenfield project, public-private partnership, mergers, acquisitions(Raff et al., 2009). An exhausting list of all types of entry strategies was not found. Instead, different studies seem to propose slightly different definitions of market entry strategies and the concepts entry mode and market entry strategy appear to be often used interchangeably. From internationalization theories, M. Lippe derived which entry modes are most often associated with a specific type of entrant(van der Lippe, 2014). It can be seen from Figure 4.1 that de novo entrants are associated with the entry modes: entrepreneur and spin-off. The aim of this study is to describe the entry strategy of de novo entrants in more detail than presented in Figure 4.1.

Green et al state that the research by McDougall from 1987 was a major step forward in the literature on entry strategy as it considered both entry strategy and entry barriers(Green et al., 1995). Since the space industry is subject to many entry barriers, it is relevant to discuss both the concept of market entry strategy and market entry barriers in this study.

4.3.2 Market entry in the space industry

Market entry in the space industry addressing specifically entry in the public market was described by Schmidt (Stefan, 2014). There was no mention of a specific market entry strategy, however three criteria for successful entry in the public market were mentioned: experience, network, and seed investment. Schmidt argues that due to the pressure on space agency budgets, it is more obvious to choose a supplier with sufficient experience. Furthermore, Schmidt mentions network as a criteria because space projects are complex and one needs a network in

Author	Category	Subcategories		
Som	**Foreign Direct Investment**	Acquisition	Greenfield	Joint venture
	Exporting	Exporting	Franchising	Licensing
Helfat & Lieberman	**Diversifying entrant**	Acquisition	Internal growth	
	Parent-company	Parent spin-off	Franchising	Joint venture
	De novo entrant	Entrepreneur spin-off	Start-up	
Slangen & Hennart	**Activity mode**	Exporting *versus*	Foreign production	
	Ownership mode	Joint venture *versus*	Foreign owned enterprise	
	Establishment mode	Acquisition *versus*	Greenfield investment	

FIGURE 4.1: Different types of entry modes from internationalization theory. Figure from (van der Lippe, 2014)

order to gain enough resources to overcome this complexity. Network also facilitates technology transfer resulting in more profits as more markets can be entered and network is said to be a competitive advantage of the incumbents. Finally, seed investment was nominated as a criteria because it might be a prerequisite for meeting the before mentioned criteria, experience and network. Building or buying into the space network as well as technology demonstration are costly and thus require high initial investment.

4.4 Conclusion

The literature on innovation and the innovator's dilemma is widely supported and provides enough argumentation for the relevance of this study. From the literature review on business models it can be concluded that there is no consensus on the definition, the purpose and the structure of business models. Therefore it is really hard to look for business models in the space industry since it is not clear what can be defined as a business model. The so called business models that were found in literature are general descriptions of a companies logic rather than different business models per se. It can therefore be concluded that it is unclear whether Section 4.2.5 actually reviews business models. Furthermore, there are many frameworks of business models and the one chosen in this study is very extended as this allows for a clear structure in the analysis of interviews. The business model canvas (BMC) is much criticized so this has to be taken into account when using the BMC for analysis of the interviews. One of the critics on the BMC is that it is too static. A business model can change over time which is not accounted for in the BMC framework. The aim of this study is to focus on the prevailing business model prior to market entry. It is very likely that a business model will change after

market entry. There is many literature that states that business models and entry mode, which can be seen as an component of market entry strategy are related. One of the critics is that strategy is not accounted for in the BMC. Entry mode is often related to market entry strategy and should therefore be seen as a different concept. However, the difference between entry mode and business model could not very well be defined. There is evidence for linking business models to entrepreneurial outcomes and therefore hypothesizing that business models are linked to successful market entry was considered legitimate. Market entry strategy is a concept which is very hard to define. The working definition used for market entry strategy is deliberately chosen to be very vague as the field of market entry in space is very unexplored. This does make it hard to analyze market entry strategy in a clear and structured way. Chapter 5 will clearly define how the concept market entry strategy will be used in the analysis of the interviews. Finally, it is surprising that market entry is most often related to internationalization theory. Strategies that are focused on domestic markets and especially for markets which are hard to enter appear to be unexplored. This research therefore has the potential to add to domestic entry strategy literature.

Chapter 5

Methodology

This Chapter will elaborate on the research methodology of this study. The first Section will explain the research approach and design, the second Section will explain the data collection approach, the third Section will discuss the analysis of the theoretical framework and finally, the fourth Section will reflect on the research quality.

5.1 Research approach & Design

The nature of this research problem typically suits a qualitative research approach. Qualitative research is the preferred approach when little is known on the subject of interest (Strauss and Corbin, 1998). As discussed in Section 2.4, the main research question is concerned with how and why because very little is known about the current developments in the commercial space industry underpinning that theory development on this topic would be of great added value. The how and why questions refer to understanding how and why market entry strategies, policy instruments, entry barriers and business models relate to successful market entry. This study can be further categorized as exploratory research for the same reason, the concept of market entry in commercial space has attracted little attention thus far (Edmondson and McManus, 2007). The main focus is therefore to discover concepts that could be related to successful market entry in European commercial space and to formulate grounded theory. The outcomes of this study can be used as a basis for new research which could involve more specific research questions.

Based on the qualitative approach, a matching research design can be defined. The research design selected is a multiple case study as it allows measuring contemporary phenomena in its usual context which generally answers research questions concerned with how and why (Yin, 2009). A case study protocol will therefore be drafted. The practical aspects and the quality of the qualitative research design will be further discussed in Chapter 5.

Section 2.4 already stated that the objective of this research is comparing various business models and market entry strategies of new entrants in the space industry so that determinants for successful market entry can be identified and subsequently used to make recommendations for European policies. The business models of these companies will be mapped and compared to each other. The market entry strategies will be described, classified and compared as well.

Two types of research are combined in this study. Empirical research in the form of interviews and a literature review. The unit of analysis for this study are new businesses in European commercial space. In order to research new entrants in commercial space, the commercial space market first needs to be characterized. As commercial space is relatively new, not much research is done on this subject. Therefore, first an interview was conducted with two experts. A person that has many years of experience in commercial space and is CEO of a commercial space company and a person with many years of experience in space policy working for the Dutch government. The scope of the research was based on these interviews. The main practical problem of innovation in the space industry was confirmed in these interviews as well as the variables that are subject of this research. Then, a literature review was performed on the market characteristics and the specific variables in the context of European commercial space resulting in Chapter 3 elaborating on the practical problem. Then a more general literature review was conducted in order to elaborate on the scientific problem. The empirical research consists of six case interviews of which the set up will be explained in more detail in the coming sections.

5.1.1 Sample

Since this is the first study conducted on this subject, the preferred data collection method is face to face interviews in order to have face validity and escape the drawbacks related to phone interviews(Wilson, 2014). The choice of face to face interviews results in a sample consisting of only Dutch companies. However, the companies all operate on the European market and are subject to European law. Therefore, the results are presented as European commercial space while all founders were Dutch and all the companies are based in the Netherlands. The results of this research should therefore be viewed in the perspective of the Dutch space market.

As explained in Chapter 2, market entry in commercial space is not self-evident due to entry barriers like high start-up costs, long development time, high quality standards, a high level of business concentration and many more. These specific problems are mainly relevant to space primes, and therefore only a few space primes exist which are primarily focused on the public space market. Privately held Dutch companies that identify themselves with the new space movement as defined in Chapter 3, that are founded around the year 2000 or later and that have entered or are currently in the process of entering the commercial space market as a space prime are included in this research. There are not many companies that are eligible for inclusion

based on these criteria. With the help of the aforementioned space expert, six companies were identified and approached by email. All six companies were willing to cooperate and found the research question relevant. No more than six companies were included due to time limitations. Both companies that have entered, or are currently entering the commercial space market are included in this research as retrospective research is known to have less validity (Hardt and Rutter, 2004). Including both companies that on the one hand have entered or on the other hand are currently in the process of market entry also provide insight into the developments of the space market over time and ensures that this study is still relevant due to the usage of contemporary data. This also has drawbacks, as half of the companies are still in the process of market entry, it can not be yet measured if their market entry was successful. This is a limitation of the sample, as only three companies have successfully entered the European commercial space market. The reference class of companies is therefore actually only three companies instead of six. There are very little space primes (producing complete space systems) in the Netherlands that are not spin-off companies of large incumbents. All the possible Dutch space primes are included in this study, as confirmed by the expert who identified the companies in this sample. Company F was not identified at first as this is a bit of a special case. As it is a spin-off from a Chinese company but aiming to enter the European market, it was considered to be different and independent enough to be included in this study.

5.2 Data collection and analysis

Both primary and secondary data collection methods were used in this study, namely interviews and literature research.

5.2.1 Interviews

The general set-up of the case study protocol will be discussed in this Section. Semi-structured interviews with experts were considered to be the best method of data collection to this study. Semi-structured interviews are open enough to discuss new topics while at the same time they ensure consistency between all interviews. All interviews will be recorded (with consent) and lasted between 60 to 75 minutes. The interview questions are listed in Appendix A. The scientific basis for the interview questions will be provided in Section 5.3.5. This research is concerned with business models and market entry strategies which are topics that company owners usually not share with the general public. It will be emphasized that the interviews will solely be a contribution to science and will not be impacting the competitive advantages of the participants. The results of the interview will be kept anonymous. The interview questions were sent to the participants before the interview took place. The interviews took place a the specific company. All respondents provided feedback on the interview results.

5.2.2 Data analysis approach

The interview data was analyzed using frameworks for business model analysis and market entry strategy analysis as will be explained in the Section covering analysis theoretical framework. No coding software was used for the analysis of the interview data. The data analysis was done by the interviewer's judgment only as the experience and perception of the interviewer was considered to be more reliable and relevant than coding software in this specific research (semi-structured interviews and qualitative research). The results were validated by the interviewees which provided feedback and then approved the results Chapter.

5.3 Analysis theoretical framework

The theoretical framework was constructed based on the template for a research framework of Verschuren et al(Verschuren and Doorewaard, 2010). First, the literature review was used to develop a conceptual model and then the cases were confronted with the conceptual model leading to the data that had to be analyzed. The theoretical framework is shown in Figure 5.1. Recommendations for European policy instruments are the final deliverable of this research. Policy recommendations were based both on the literature review on the policy framework and on the interviews as the interviewees were asked to provide policy recommendations.

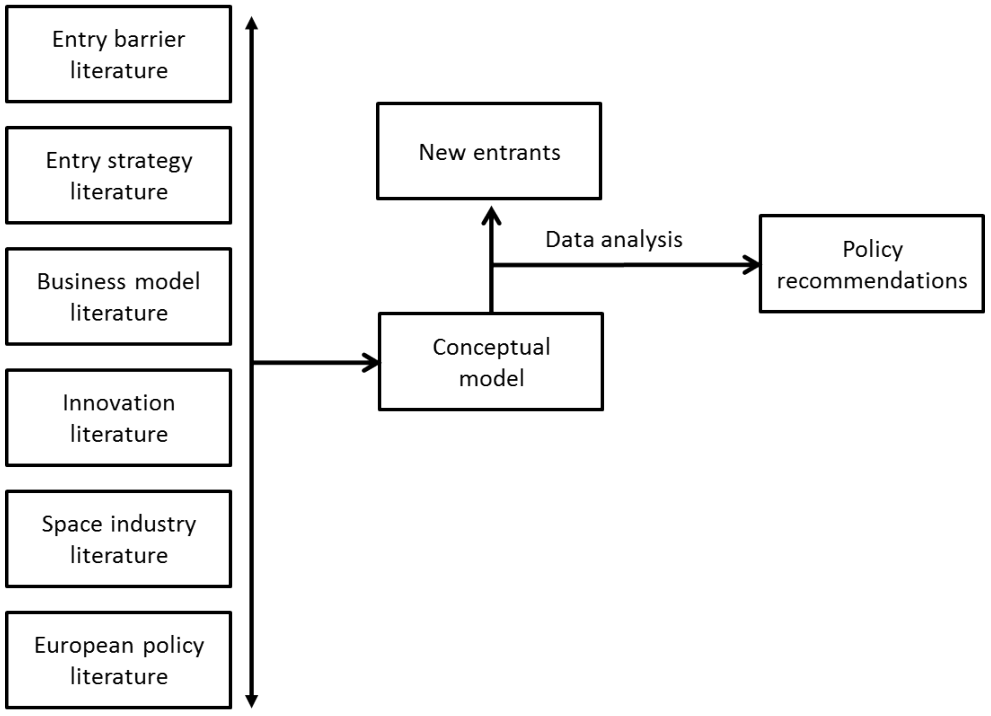

FIGURE 5.1: The business model canvas for company A.

The conceptual model is shown in Figure 2.3. The independent variables are business model and market entry strategy, the moderating variables are entry barriers and European policy

instruments and finally the dependent variable is successful market entry. The following subsections will discuss how each variable needs to be analyzed. In order to test the interrelations as presented in the conceptual model, the interviewees were asked if they think that the different concepts relate to each other.

5.3.1 Business model

As discussed in Section 4.2.5.6 the business model canvas of Osterwalder et al was considered the best fit for the research. The business model canvas consists of nine building blocks and every building block was translated into an interview question. The interviewee was asked to describe that the specific part of the business. From the interviews, a business model canvas was created for every company included in this research. Next to the business model canvas, a story was created in order to explain the interrelations between the various building blocks as recommended in previous research (Coes, 2014).

5.3.2 Market entry strategy

The interviewees were asked to describe their market entry strategy and were provided the definition of market entry strategy as stated in Section 4.3.2. Results will be classified in entry location, entry timing and entry mode. Especially entry mode is not very well defined in literature. Entry mode is mainly concerned with the how question and that is used as a handhold for filling in this component. The concept market entry strategy is much broader than this, as it also involves goals, plans and decisions. This part is more vague and harder to measure. Therefore this part of the concept market entry strategy will be covered in the corresponding elaboration on the market entry strategy results. This content included in this elaboration is very dependent on where the interviewees themselves concern most important in their market entry strategy.

5.3.3 Entry barriers

The interviewees were asked to describe the entry barriers they encountered and were provided the definition of entry barriers as stated in Section 3.7.

5.3.4 European policy instruments

The interviewees were asked to describe policy instruments they used and were provided the definition of policy instrument as stated in Section 3.6.

5.3.5 Successful market entry

Successful market entry in this research is defined as offering space hardware products to the market, thus having completed the commercialization phase. In this study, it was assumed that the offerings of new entrants would stimulate (disruptive) innovation in the space market. Therefore, measuring the concept successful market entry will only be based on having the products available to the market and will not include an extensive analysis on market performance as this is considered to be out of scope.

5.4 Research quality

As described by Yin, the quality of the case study depends on three aspects: Construct validity, internal validity and external validity(Yin, 2014).

5.4.1 Construct validity

Yin states three approaches that increase the construct validity: use multiple sources of evidence, establish a chain of evidence and have key informants review the initial draft of the case study. All these approaches were incorporated in this study to ensure construct validity. Multiple sources of evidence will be used in this study as six cases will be analyzed. A case study database is used to maintain a chain of evidence that contains all the interview transcripts. The interviewee was given the chance to provide feedback on the findings from the interviews.

5.4.2 Internal validity

This study is explorative in nature and therefore internal validity does not play a large role in this research (Yin, 2014). Causality between certain factors and successful market entry will only be hypothesized and not tested quantitatively.

5.4.3 External validity

External validity is concerned with identifying to which domain the results of the study can be generalized. This study focuses on Dutch new entrants in the European commercial space industry. The challenge will be to distinguish determinants for successful market entry as a Dutch company from general determinants applicable to the entire European industry. The space industry is very specific so the results of this study cannot be generalized outside of the space industry.

5.4.4 Reliability

The reproducibility of the results is ensured by having a clear case study protocol explaining all the data collection methods. Furthermore, as mentioned in the Section about construct validity, a case study database was constructed which will also contribute to the reliability of this study.

Chapter 6

Results

6.1 Description of the cases

This section will provide an overview of all the cases included in this research. The results from the interviews with will be presented for every company independently. The interview questions can be found in Appendix A. Small and medium sized Dutch companies (in terms of employees; $<$ 250 employees) that are currently producing or planning to produce space hardware are included in this research. All companies produce full systems that will operate in space. Table 6.1 provides an overview of the characteristics of these different companies. Many of the included companies have a much broader portfolio than just space hardware but the focus of this research will be the space hardware products, and the relation of these products to the other product or service segments of the company (if there are any). The employees interviewed were all founding CEO's or CFO's.

TABLE 6.1: Characteristics of the different space hardware companies

	Founding year	**Employees (#)**	**Space hardware product**
Company A	2006	50 - 100	Small satellites
Company B	2000	150	Atmospheric re-entry measurement system
Company C	2011	$<$ 10	Sounding rockets
Company D	1998	10 - 50	Measurement devices
Company E	2016	10 - 50	Low power global area network
Company F	2016	$<$ 10	Small satellite constellations

First of all, a general overview of the products or service of the specific company will be presented. Furthermore, the position of the company in the space value chain will be discussed. Then, for every company a business model canvas was created that outlines the most important concepts of the company's business model. The market entry strategy, entry barriers, policy instruments and the relation of these concepts to the companies business model will be discussed as well. Finally, problems related to government involvement in the Dutch space sector that were identified by the interviewees will be discussed. The aim of this Section 6.1 is to provide

a factual, written representation of the interviews. Section 6.2 provides contextual conditions for interpreting the results and finally the aim of Section 6.3 is to interpret the findings and to discuss and to interrelate them.

6.1.1 Company A

Company A can be classified as a space prime and was founded in 2006 with the aim to sell complete small satellite solutions. Company A was founded by aerospace engineers as a spin-off from an university nanosatellite project. Company A now has 80 employees, 76 cubesat products available, 2 spin-out companies and 250 satellites launched in 12 launches at 5 different launch sites. Company A was a first mover that was focusing on the niche market for more detailed data complementary to the data that the large institutional satellites were able to supply. As they were one of the first, they had to build the whole value chain themselves and they needed to gain trust of their intended customers. Company A was able to do that by selling smaller components and launch services first as a less risky alternative to complete systems (walk before run strategy). As they were first movers, clients did not had any alternatives so were more likely to accept the risk associated with small satellite products. Although company A intended to supply only full satellite solutions, they became: quote 'a one stop shop' that also sells components and other related equipment in order to make their company more attractive for their intended customers. They now sell complete satellite solutions, components, cubesats and launching services. Figure 6.1 illustrates which part(s) of the space value chain involves the activities of company A. Figure 6.1 shows that company A is vertically integrated, they control the whole value chain and are a one stop shop that is able to deliver products to any type of client in the value chain. In most of the cases, they sell complete satellite systems (including equipment for operating and ground systems), however they are capable of delivering data services as well. Company A does not own rockets themselves but are launch brokers, meaning that they do own some space inside rockets and therefore launching is depicted as shared between the company and the (launching) partner.

6.1.1.1 Business model canvas

The business model canvas of company A is presented in Figure 6.2. Company A serves all types of customers that are interested in small satellite related products or services. The main customer segments of company A include young researchers/universities, research institutes, institutional clients and new space clients interested in infrastructure. Company A describes itself as a turnkey service provider meaning that their products are ready for immediate use. Their main strengths include that they can provide everything related to small satellites a client could possibly need. They are also able to launch the satellites within a short time frame and be cost effective at the same time as they are a launch broker. Being a launch broker allows

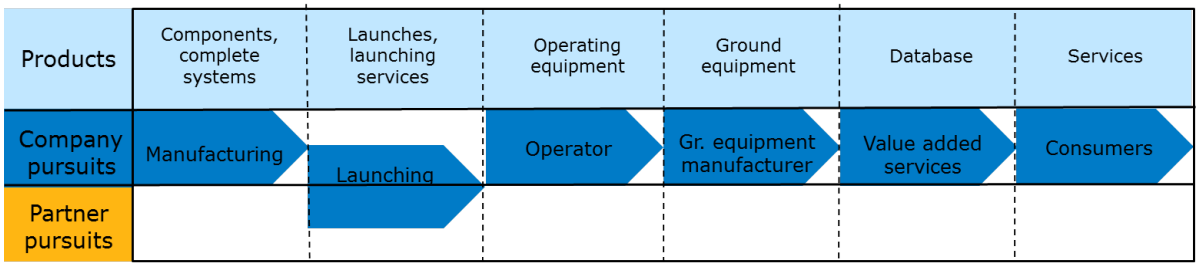

FIGURE 6.1: This figure shows that Company A is able to perform activities on all levels of the space value chain. They even offer products or services on all levels of the space value chain. They manufacture space hardware and sell components or complete systems, they launch space hardware which is a shared activity that they perform with a partner, they operate the space hardware and sell operating equipment, they manufacture, operate and sell ground equipment, they are able to construct databases as a value added service and are even capable of providing services based on space data which are ready for use to consumers. Company A is not positioned somewhere in the space value chain but covers all levels of the space value chain.

company A to be: quote 'a travel agency for small satellites'. The one stop shop principle allows them to gain trust from their customers and to educate their customers on every aspect of small satellites. Company A stated that they are currently looking for innovation partners as they are getting higher sales volumes, resulting in less time available for innovation. Company A was one of the first players in the field, and therefore have a track record and are a trusted supplier of space products. As they have higher sales volumes and a lot of standard requests, they have a webshop and work with sales agents. However, most sales is still very personal. They specifically mention that their specialized engineers are a very valuable and costly asset of their company. Their engineers come from all over the world.

6.1.1.2 Market entry strategy

As explained, Company A was a first mover and focused on a niche market. Because of their involvement in an university satellite project prior to founding the company, they were provided education, were able to build a relevant network and had access to resources in order to research satellite technology, all in the protected environment of the university project. The founders of company A identified the niche market for small satellites and were confident that there R&D efforts would be able to provoke new customer needs (technology push rather than market pull). They had no other choice than to become vertically integrated as there were no relevant partners since the small satellite market was in a very early stage at that time. Therefore, they could not just position themselves somewhere in the value chain, but had to provide the complete value chain themselves. Consequently, they decided to provide products on all levels of the value chain. The market entry strategy of Company D is summarized in Table 6.2.

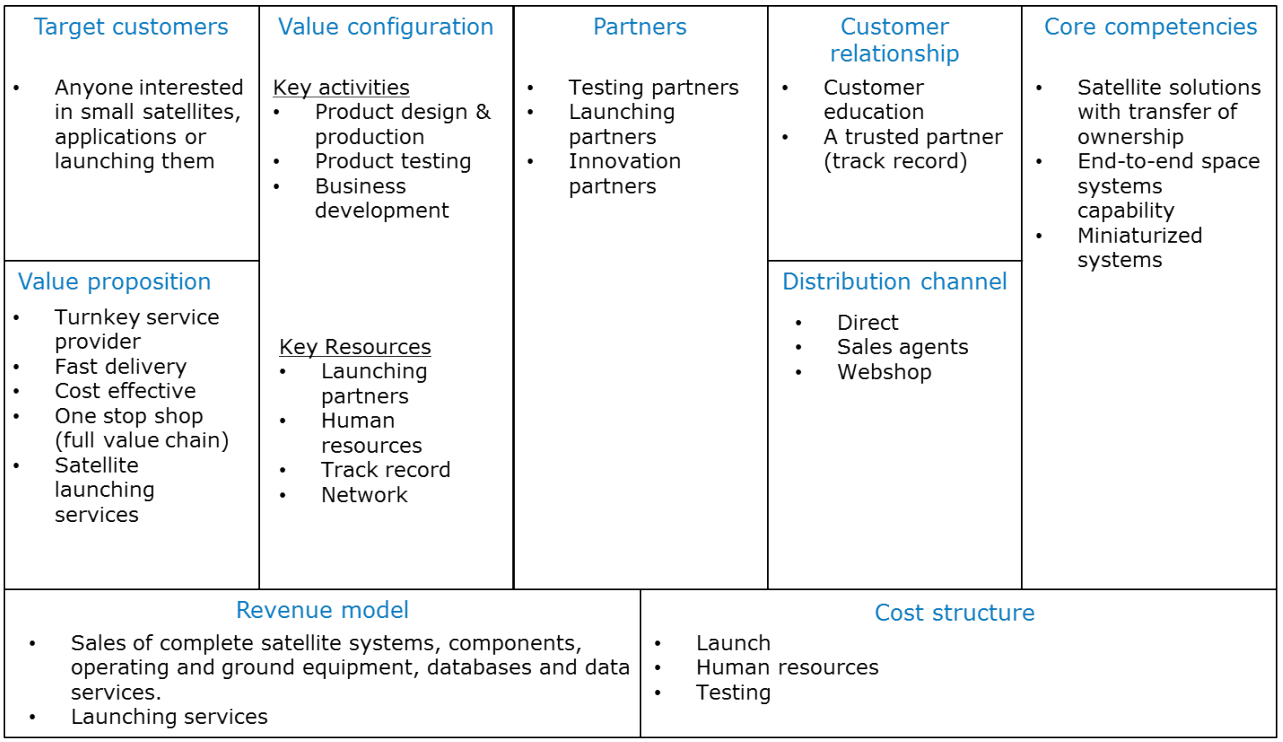

FIGURE 6.2: The business model canvas for company A.

TABLE 6.2: Entry location, entry timing and entry mode of company A

Entry decision	**Company choice**
Entry location	Small satellite market (niche)
Entry timing	Pioneer/ first mover
Entry mode	Vertical integration

6.1.1.3 Market entry barriers

The market entry barriers which company A encountered and their reaction by which they successfully overcame the barrier are listed in Table 6.3.

TABLE 6.3: Entry barriers and reaction to them of company A

Market entry barrier encountered	**Company reaction**
High start-up costs	• Government investment • External investment • Technology miniaturization
Long term institutional budget	Right time, right place, right subject
Competition of the large incumbents	Go niche
Production partners hard to find	Vertical integration
Complex technology	Attract specialized engineers

High start-up costs is an inevitable market entry barrier when entering a highly complex technology market. Company A reacted to this barrier by looking for investors and by miniaturizing their technology. Technology miniaturization drastically lowers the production and materials

costs. Company A was lucky to be granted multiple governmental funding incentives quote: 'we were at the right time at the right place'. Therefore, they had enough resources in order to do the required R&D which led to their miniaturized products. Furthermore, company A had already experienced the way of working of the large incumbents and realized that they were not able to compete with them so they choose to focus on a niche market. Finally, company A stated that specialized engineers are a prerequisite for producing highly complex technology. These engineers are scarce and expensive and attracting them is thus a market entry barrier. By being innovative and a first mover, company A was able to attract these engineers from all over the world.

6.1.1.4 Influence of policy instruments

The policy instruments were essential for company A to overcome the barrier of high investment costs and therefore were essential for market entry. Company A used or was involved in:

- Pre-qualification ESA programme (PEP)
- European horizon 2020 grant
- European FP7 grant

6.1.1.5 Concept relations

The interviewee was asked if he or she thought that there was a relation between the company business model and the market entry strategy, the policy instruments and the market entry barriers. Results are shown in Table 6.4.

TABLE 6.4: Concept relations in the case of company A

	Entry strategy	**Entry barriers**	**Policy instruments**
Business model	✓	✓	

The market entry strategy relates to the business model as a first mover niche strategy requires vertical integration. Furthermore, entry barriers relate to the business model as competition of large incumbents forces a company towards niche markets and high start-up costs can be dealt with by technology miniaturization. Company A states that their business model does not relate to policy instruments. They deliberately did not do this, as they want to be independent.

6.1.2 Company B

Company B was founded in 2000 and started with developing space software for ESA. To date, their main clients encompass institutional clients or other large space primes. Company B stated that: quote 'we were a classic space company with mostly institutional clients but we

are currently on the path of transiting to new space and now also focusing on commercial space clients'. Company B was founded by four people and has grown to 150 employees today. The main business of company B encompasses sensing and control systems, scientific data processing, intelligent software applications and technical consulting in the field of space, science and defence. At the moment, company B is working as a prime on their first space hardware project for ESA which is planned to be ready in 2018. Company B will do this together with 7 other international partners. Company B initially did not intend on building space hardware as the technology is very complex and the projects are risky, but an opportunity in the market presented itself and company B decided to take its chance. Furthermore, broadening the product portfolio with an ambitious complex project allows company B to grow even more.

The space hardware project is the project of interest for this study and comprises the development of an atmospheric re-entry measurement system. This analysis is focused on the space hardware project, so other aspects of the companies product portfolio will be left out of consideration unless there is a link to the space hardware project.

The re-entry measurement system is able to monitor the re-entry of large rocket systems in the Earth's atmosphere so that it can be investigated whether or not the space systems will fully disintegrate. Full disintegration is required as European law states that it is illegal to leave any objects behind in space. However, Europe does not have a measurement system for this purpose that is produced in Europe. Europe either has to buy such a re-entry measurement system abroad or has to fully rely on disintegration simulations. Company B will be the first European supplier of a re-entry measurement system.

Figure 6.3 illustrates which part(s) of the space value chain involves the activities of company B. The activities of company B involve all parts of the value chain. Company B is a system integrator, it operates the system and develops software for the data analysis resulting in their final product which is a service they deliver to their clients, launchers of large rockets (e.g. Arianespace that launches Vega rockets). They are not vertically integrated, so the manufacturing of the sub-systems and ground equipment is done by partners.

6.1.2.1 Business model canvas

The business model canvas of company B is presented in Figure 6.4. The main value of the re-entry device is that it is a license to launch in the case of European launchers. Furthermore, it is made in Europe which is of strategic value as it makes European launchers independent from foreign parties which has multiple benefits. European launchers prefer European products as it decreases the risks in their supply chain and saves costs as it is more of a partnership than just a supplier.

Company B wants to deliver a trustworthy and technologically superior system in order to attract both European and foreign launchers as potential customers. Since this is a complex

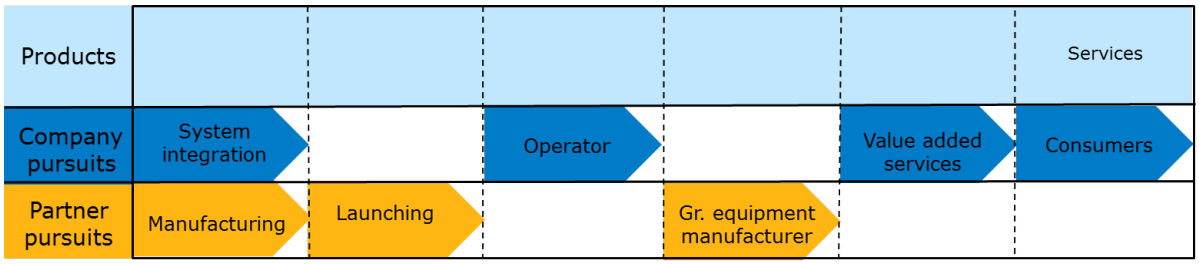

FIGURE 6.3: This figure shows that Company B is able to perform activities on all levels of the space value chain. They however only offer services based on space data directly to the consumers. In order to realize their service, company B must also perform activities on higher levels of the space value chain. Company B is a system integrator so the manufacturing of components (also ground equipment) is done by a partner, a partner also takes care of launching, but company B operates their hardware themselves and processes the data into a value added service which they offer as their final product. Company B is not positioned somewhere in the space value chain but covers all levels of the space value chain

and large project, the key activities of company B include network management and supply chain management. As this project is carried out in partnership with ESA, ESA has much influence on the supply chain. The supply chain therefore cannot be constructed based purely on the criteria of best technology and cost-effectiveness. At the moment Company B is working together with ESA to get the product certified for the first type of rocket.

The resources company B requires for all these activities mainly include specialized engineers. Furthermore, company B built a good network over the years which is essential for this project as they have to know which international partners to approach in order to make their project a success. Since this project is their first space hardware project, company B had to build a product integration facility. Customers of the space hardware of company B are primarily looking for trustworthy, certified, and, in the case of European launchers, European products. The re-entry device has to be certified for every specific type of rocket. So close collaboration with the clients would be required. Company B stated that "there will not be any customization of the re-entry device as this will drastically prolong the certification phase."

The complete revenue model of company B is hybrid in the sense that the core business of company B is not just space. The highest costs in the re-entry device project are specialized engineers. As they are very scarce and distributed across Europe, their bargaining power is very high and thus they are costly.

6.1.2.2 Market entry strategy

Company B started off doing a software project with ESA which, quote: 'was a matter of being at the right place at the right time.' Subsequently, company B did many more projects for ESA. In the case of market entry in the space hardware market, company B already had a large (international) network and was already a partner of ESA. Furthermore, company B was able to make a substantial investment themselves from the profits made on prior non space hardware

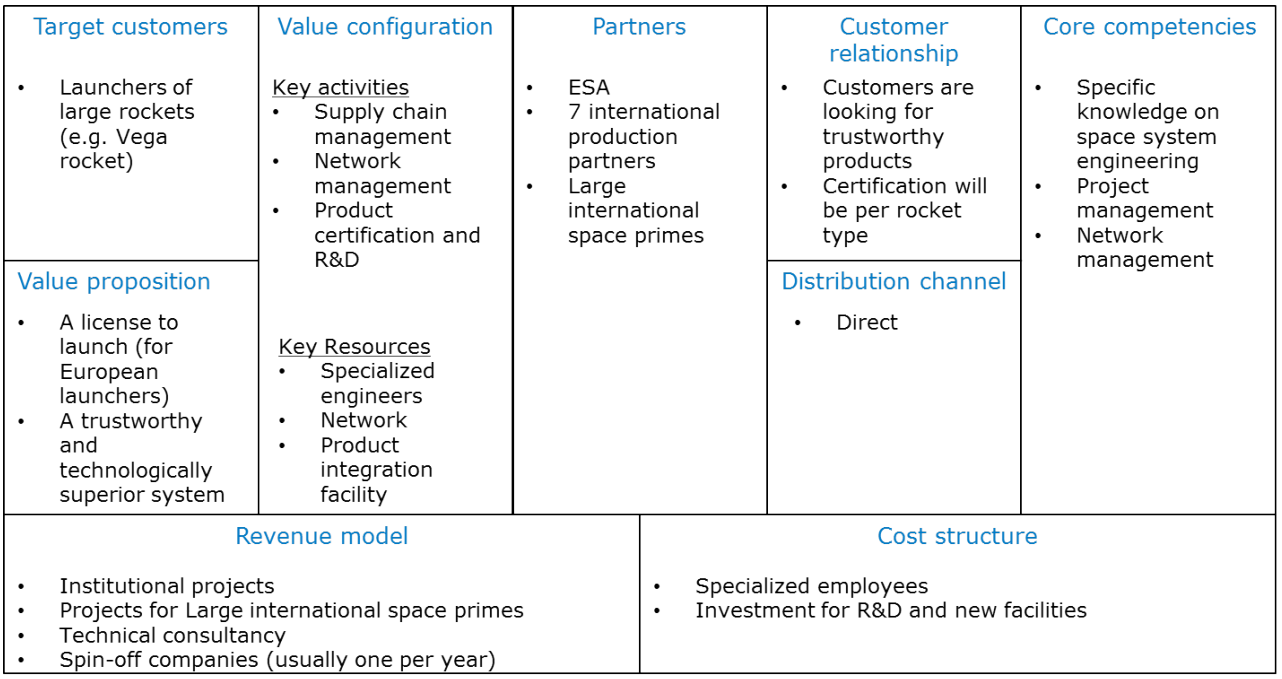

FIGURE 6.4: The business model canvas for company B.

projects. Company B had the network needed to act as a prime in an ESA project and ESA covered a large part of the R&D costs for the development of the re-entry measurement system. Next to that, company B saw the opportunity in the market because they have been there for quit a time (market pull rather than technology push). Company B thus has a very good base for starting in the space hardware industry. The market entry strategy of Company D is summarized in Table 6.5.

TABLE 6.5: Entry location, entry timing and entry mode of company B

Entry decision	**Company choice**
Entry location	Space debris
Entry timing	Pioneer/ first mover
Entry mode	Launching customer (ESA)

6.1.2.3 Market entry barriers

The market entry barriers which company B encountered and their reaction by which they successfully overcame the barrier are listed in Table 6.6.

TABLE 6.6: Entry barriers and reaction to them of company B

Market entry barrier encountered	**Company reaction**
High start-up costs	• Government investment (ESA partnership) • Had own financial resources
Competition of the large incumbents	Network management
Finding qualified personnel	Attract them by marketing your innovative project

Although company B was able to do an investment themselves and ESA covered most of the R&D costs, the investment remains really high (millions of euros) and thus remains very risky. Now that company B is acting as a prime in space hardware, they are competing with large international primes which is new for company B. The network of company B served as the key to success in this case as the large incumbents were also clients of company B before. They have good relationships with both the other space primes and ESA. Finally, promoting that your company can offer innovative large projects does attract specialized engineers and allows your company to grow and to get access to more knowledge.

6.1.2.4 Influence of policy instruments

Government factors had a large influence on the success of company B. First, the reason that company B started with space hardware is because of European law. Second, ESA was the first partner and contractor of company B and is now also sharing the risks in this project since they are facilitating the certification process. Last, ESA was the lead contractor from the beginning and helped company B to secure its position in the space market. Company B used the following policy instruments:

- ESA certification programme
- ESA contracts

6.1.2.5 Concept relations

The interviewee was asked if he or she thought that there was a relation between the company business model and the market entry strategy, the policy instruments and the market entry barriers. Results are shown in Table 6.7.

Table 6.7: Concept relations in the case of company B

	Entry strategy	**Entry barriers**	**Policy instruments**
Business model	✓	✓	✓

The business model of company B is related to the market entry strategy. Their market entry was a partnership with ESA, their business model therefor is based on institutional clients. There is also a relation between the business model and the market entry barriers as their partnership with ESA and their hybrid business model allowed company B to overcome the high start-up costs of this project. Finally, policy instruments clearly have a relation to the business model of company B as they have many institutional clients that automatically work with these policy instruments.

6.1.3 Company C

Company C was founded in 2006, offer products related to cansats and offer engineering consultancy. They are currently developing a sounding rocket and associated launcher which is the main product of interest for this research. The founders are young passionate rocket engineers that were a part of a student amateur rocketry team that builds cansats and small rockets. Consequently, company C started as a company revolving around cansats in cooperation with ESA for a space education project. When the cansat project expired, company C broadened their portfolio and started offering consultancy services and developing sounding rockets. They redesigned the classic sounding rocket in order to create technologically superior and cost efficient sounding rockets in comparison to the market standard. Company C intends to have their sounding rocket commercially available by the end of 2018, they are now in the technology validation phase. Company C considers the sounding rockets for space applications their core business. Sounding rockets are generally used to perform measurements at altitudes between 50 and 120 km for research purposes.

Figure 6.5 illustrates which part(s) of the space value chain involves the activities of company C. Company C is vertically integrated so the complete manufacturing of their rockets, launchers, and ground equipment is done in-house. Company C intends to sell complete solutions, rockets with launchers and ground equipment together with launching services and as a final product, a database ready to use for research. The clients will have to do the data analysis.

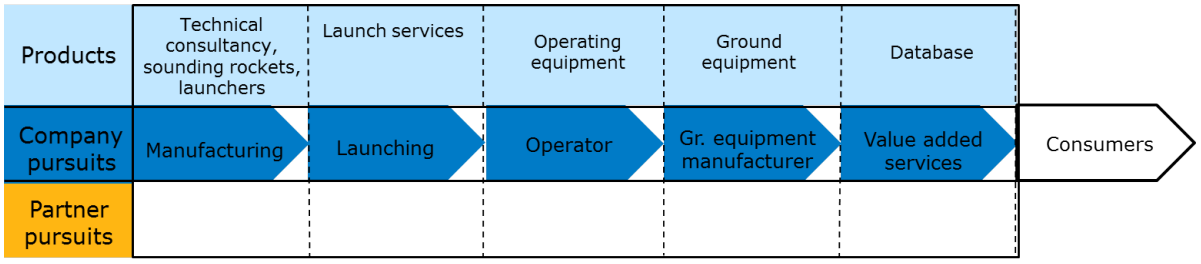

FIGURE 6.5: This figure shows that Company C is able to perform activities on almost all levels of the space value chain. Their final product is a database ready to use for research. Company C manufactures space hardware and ground equipment and sells complete systems, they launch space hardware themselves, operate the space hardware and deliver a database as a value added service. Company C is not positioned somewhere in the space value chain but covers almost all levels of the space value chain.

6.1.3.1 Business model canvas

The business model canvas of company C is presented in Figure 6.6. Company C focuses on customers interested in research applications. For company C these are both institutional and commercial clients. Furthermore, the sounding rockets of company C can be used to investigate the air conditions prior to the launch of a large and expensive rocket in order to determine if the current air conditions are favourable for launching, thus providing a risk estimation. Potential

clients are therefore rocket launchers as well, which will generally not buy a product before the validation phase is completed. Company C will be involved with the research of its customer as it will provide launching and measurement assistance and will take into account the individual needs of its customers. Finally, the sounding rockets can also be used for non-space applications by defence organizations. Company C offers a sounding rocket that has superior technology while being less expensive and able to launch more frequently than other sounding rockets that are currently available. Company C is vertically integrated, with the production of the rocket fuel being the most difficult and expensive part of their production process. However, if the sales volume would go up in the future, company C would need to outsource its system integration. Company C spends much time on finding investors and working on their product validation in order to get their rockets ready for commercialization. Company C uses the profits of their consultancy services and side projects as an investment in their sounding rockets. Company C has many partners for testing and the provision of equipment but testing still remains a large expense. Company C has engineers with unique specialized knowledge in small rocket engineering which is their biggest core competency.

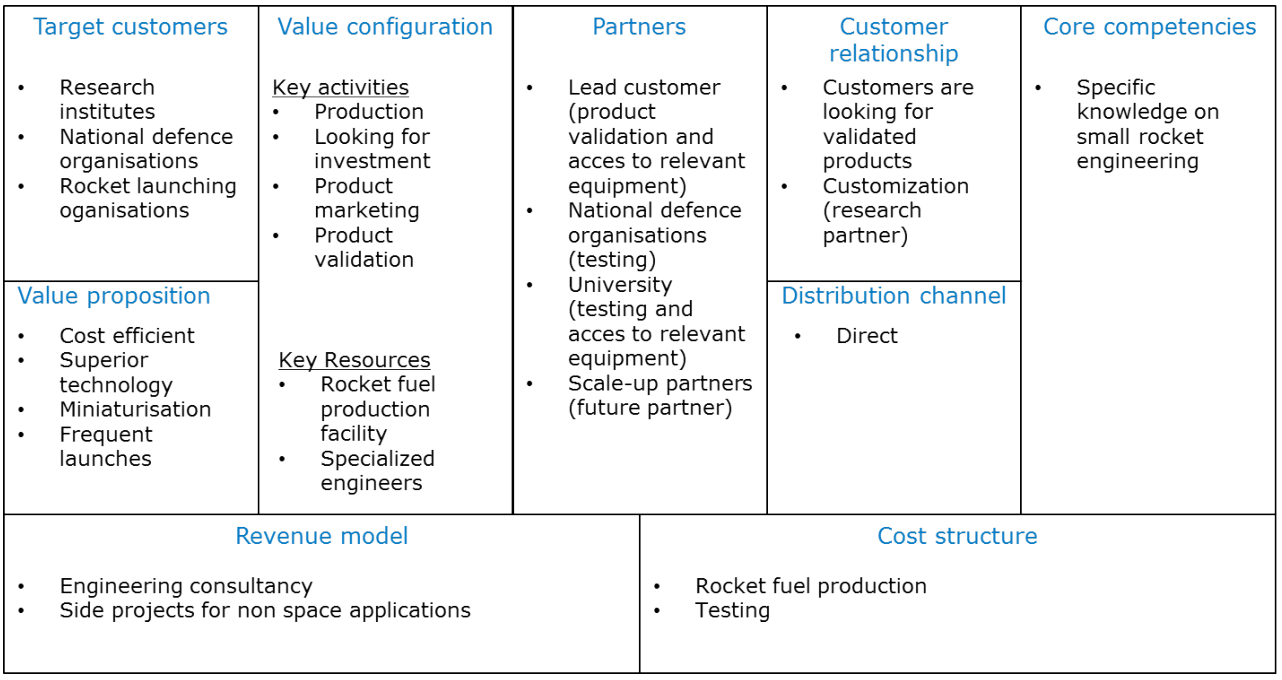

FIGURE 6.6: The business model canvas for company C.

6.1.3.2 Market entry strategy

Company C attracted a launching customer that is sponsoring the product validation phase (Company C does need additional investment) and with who they have a minimum purchase amount when the product is ready for commercialization. Company C intends to demonstrate their product together with their launching customer and hopes to attract new customers in this way (a technology push rather than a market pull). The market of sounding rockets is still

underdeveloped and company C is definitely a first mover/pioneer that aims for a technologically superior product. Company C had to choose for a vertical integration model as there are no suitable production partners. The market entry strategy of Company D is summarized in Table 6.8.

TABLE 6.8: Entry location, entry timing and entry mode of company C

Entry decision	**Company choice**
Entry location	Sounding rockets
Entry timing	Pioneer/ first mover
Entry mode	• Vertical integration • Launching customer

6.1.3.3 Market entry barriers

The market entry barriers which company C encountered and their reaction by which they successfully overcame the barrier are listed in Table 6.9.

TABLE 6.9: Entry barriers and reaction to them of company C

Market entry barrier encountered	**Company reaction**
High start-up costs	• Government investment • launching customer with minimum purchase amount • Had own financial resources • Redesign sounding rocket • Technology miniaturization
Long development time	• Overcome financial burden by consultancy and side projects • Non-space side projects (e.g. Defence projects) • Engineering consultancy
Risk averse investors	Invest time to educate investors and gain their trust
Risk averse clients	Demonstrate product with launching customer to gain their trust
Long term institutional budget	-

Reasons for the long development time include: aiming for a technologically superior product, redesigning a complex product like sounding rockets takes time, inevitable side projects to cover the costs and finally grant applications that are time consuming as it is a a requirement that the company will raise half of the requested amount of the grant themselves. A barrier which Company C did not overcome was to get access to the institutional budget as their product does not comply to the guidelines described by the national roadmaps.

6.1.3.4 Influence of policy instruments

Company C used the following policy instruments:

- Regional grant

- European horizon 2020 grant

Company C is not fully dependent on this financial support as it is not a significantly large share of their revenue and there was much uncertainty upfront if these instruments would even be granted.

6.1.3.5 Concept relations

The interviewee was asked if he or she thought that there was a relation between the company business model and the market entry strategy, the policy instruments and the market entry barriers. Results are shown in Table 6.10.

TABLE 6.10: Concept relations in the case of company C

	Entry strategy	**Entry barriers**	**Policy instruments**
Business model	✓	✓	

Company C states that there is a relation between the business model and the entry barriers since they developed a business model in which they offer engineering consultancy next to their core business of sounding rockets. Company C needs the consultancy projects in order to finance their space hardware development. Furthermore, company C choose to work on small rockets in order too avoid extremely high initial development costs and redesigned the rocket so that the costs could be brought down even more.

The entry strategy also has a relation to the business model since company C attracted a launching customer as a partner in order to deal with risk averse investors that are not familiar with sounding rockets. Also they needed the launching customer in order to overcome the validation phase and to gain the trust of other clients (influence the customer relationship). The pioneer strategy required company C to be vertically integrated. Policy instruments were not thought to be related to the business model since it was not certain upfront if company C would be granted those instruments.

6.1.4 Company D

Company D was founded in 1998 by physicists and now has 40 employees. The company sells innovation projects that result in a minimum viable product (MVP) being a type of miniaturized measurement device. Company D manages and executes these innovation projects together with universities and the industry. The measurement devices of company D are based on space technology and can have their application in various sectors like space, agriculture or pharma. Company D has the role of space prime and serves clients in both the institutional and the commercial market. Company D was a first mover in the niche market of miniaturized space products and was one of the first companies dedicated to offering services on the interface of both

the academic and commercial sector. As Company D was one of the very few parties offering this type of service and has founders that were prior employees of ESA, they were able to work with ESA from the beginning. Company D guarantees effective innovation management but does not guarantee the outcome of the innovative research project as it is impossible to predict that up front. Figure 6.7 illustrates which part(s) of the space value chain involves the activities of company D. Company D either sells complete systems with ground equipment and software in a transfer of ownership mode or operates the product itself and sells a database as a final product. The products that company D developed can also be sold independently to other parties but most of the time company D sells innovation projects. Company D is a prime and therefore tests and integrates the measurement systems. However, company D also develops software in order to deliver databases as final products. Company D sometimes creates their own clients in the form of spin-off companies focused on data interpretation as a value added service for consumers.

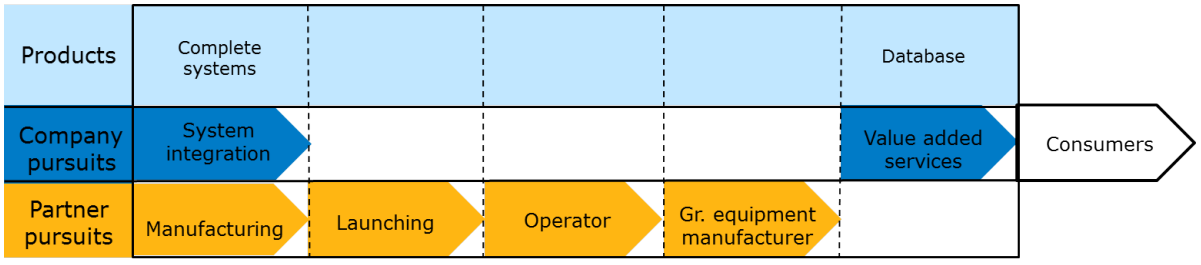

FIGURE 6.7: This figure shows that Company D is able to perform activities on almost all levels of the space value chain. Company D is a system integrator so the manufacturing of components (also ground equipment) is done by a partner, a partner also takes care of launching, but company B operates their hardware themselves and processes the data into a value added service which they offer as their final product. Company B is not positioned somewhere in the space value chain but covers almost all levels of the space value chain.

6.1.4.1 Business model canvas

The business model canvas of company D is presented in Figure 6.8. The business model of Company D is a service model. They focus on clients for which measurement devices, that do not yet exist, could offer a huge advantage within their organization. Company D customizes the design of the to-be-developed product and finally delivers a minimum viable product by efficient project management. Company D becomes the owner of this product and is subsequently able to offer these products off the shelf, however this only accounts for 20 % of the sales. Company D states that the development of measurement devices requires an effective combination of physics and engineering skills, which is quote: 'a combination that is not self-evident'. Furthermore, company D combines research and production capabilities by partnering with both the industry and academic institutes like universities in order to decrease the development time of an innovation project. They focus on the development of small measurement devices that use space technology quote: 'not just because of space technology but because it

is necessary'. Business development is one of the key activities since sales is mostly direct via personal contact. Furthermore, company D actively manages and invests in their institutional and academic network by participating in multiple government fora and facilitating education programmes like PhD's or graduating projects. Company D is a prime, so does the assimilation integration and testing in house. Next to that company D also develops the software needed for the measurement device.

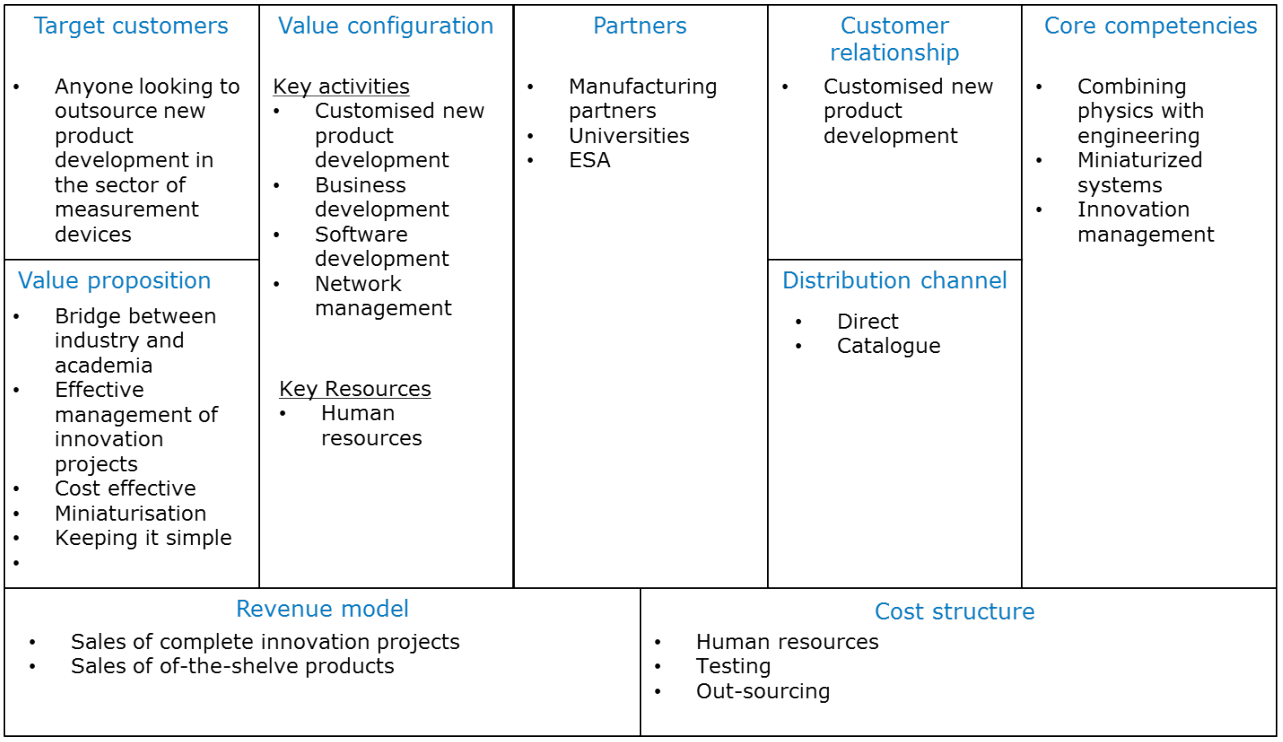

FIGURE 6.8: The business model canvas for company D.

6.1.4.2 Market entry strategy

The market entry strategy is a service model combined with a first mover strategy (first mover in the market of miniaturized space products) in a niche market (combination of industry and academia). Already having a network at ESA, company D was able to identify the needs of ESA and start doing projects with them as a launching customer from the very beginning (market pull). The market entry strategy of Company D is summarized in Table 6.11.

TABLE 6.11: Entry location, entry timing and entry mode of company D

Entry decision	**Company choice**
Entry location	Measuring devices
Entry timing	Pioneer/ first mover
Entry mode	• Service model • Launching customer

6.1.4.3 Market entry barriers

The market entry barriers which company D encountered and their reaction by which they successfully overcame the barrier are listed in Table 6.12.

TABLE 6.12: Entry barriers and reaction to them of company D

Market entry barrier encountered	**Company reaction**
High start-up costs	• Apply service model • ESA contracts • Technology miniaturization
Long development time	Technology miniaturization
Long return on investment time	Apply service model
Risk averse investors	ESA contracts
Risk averse clients	• Demonstrate product with ESA • Reduce risk by technology miniaturization
Competition of Dutch research institutes	Find clients abroad as well
ECSS certification	Technology miniaturization
Competition of the large incumbents	Go niche (miniaturized systems)

Company D focuses on miniaturized products and found that ECSS certification is not required as miniaturized products are associated to a lower risk compared to large space systems because they are less costly.

6.1.4.4 Influence of policy instruments

Company D used the following policy instruments:

- ESA contracts
- WBSO

Company D uses the WBSO policy in order to decrease their human resource expenses as most of the time is spend on R&D, for which the WBSO policy is intended. Company D states that WBSO allows them "to operate on level playing field" as it results in cost reduction. Furthermore, ESA contracts make up a significant amount of their revenues, making company D very dependent on policy instruments.

6.1.4.5 Concept relations

The interviewee was asked if he or she thought that there was a relation between the company business model and the market entry strategy, the policy instruments and the market entry barriers. Results are shown in Table 6.13.

TABLE 6.13: Concept relations in the case of company D

	Entry strategy	**Entry barriers**	**Policy instruments**
Business model	✓	✓	✓

Company D states that there is a relation between their business model and the entry barriers they encountered. Company D choose the service model because this would shorten the return on investment time and would lower the start-up costs. Furthermore, their business model has strong relations with policy instruments as ESA is a large customer with who they secured a partnership from the date of founding. Because of the launching customer entry strategy with ESA, institutional customers are part of their business model. The WBSO policy is essential for company D because it decreases their human resources costs.

6.1.5 Company E

Company E was founded in 2016 with the objective to be the provider of a low power global area network. They aim to provide an independent network with absolute global coverage using a satellite constellation. The current global telecom network has a coverage area of only 10% of the world underpinning the need for more coverage. They will use their global connectivity for tracking and monitoring of goods but also for monitoring for example agricultural or maritime business processes. Company E now consists of 15 people and was founded by persons with investment and business backgrounds with experience in the communication sector. They are currently in the development phase and they aim to have their first satellite operational in the beginning of 2018. The goal is to have a constellation of satellites that frequently tracks or monitors the object or activity of interest.

Company E is interested in clients that monitor or track high volumes of objects or activities. Company E will not directly sell to these clients, but uses an indirect model. Figure 6.9 illustrates which part(s) of the space value chain involves the activities of company E. The role of Company E in the value chain will be to own and operate the network of satellites and sell connectivity subscriptions to ground equipment manufacturers. The ground equipment manufacturers can then sell their equipment together with a subscription to the network of company E. It should be noted that company E will first have to build the whole value chain in order to facilitate a technology push for their product. But when the value chain is in place, they will only operate their network. Company E is going for a mass market strategy.

6.1.5.1 Business model canvas

The business model canvas of company E is presented in Figure 6.10. The clients that company E will have direct contact with, will be the ground equipment manufacturers. The final end users of the connectivity, the companies interested in tracking or monitoring a high volume

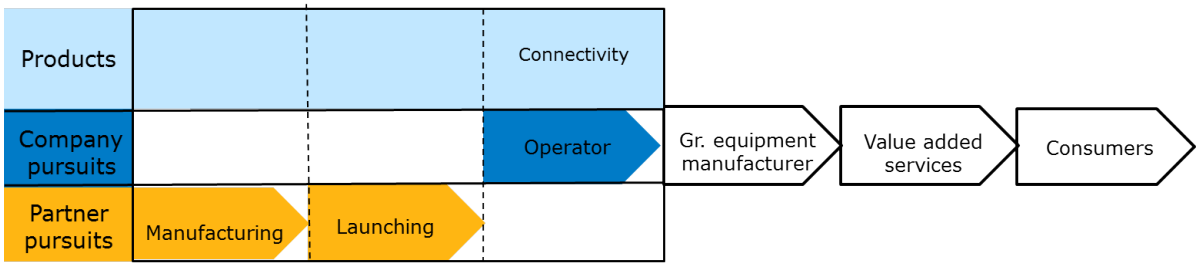

FIGURE 6.9: This figure shows that Company E is able to perform activities on various levels of the space value chain. However, before company E can execute this model, they first have to build the complete value chain. Thus although it looks like the activities of company E stop after operating the space hardware, they have to be able to perform activities on all levels of the space value chain in order to be able to build it. Company E is not positioned somewhere in the space value chain but covers almost all levels of the space value chain.

of activities or objects, are mainly actors in the agricultural, maritime and fleet management sector. As company E will only serve high volume clients, they are able to keep the costs of their subscription low. Furthermore, the type of data that they intend to process will be basic, and therefore their infrastructure can be kept relatively simple resulting in cost reduction.

A satellite constellation ensures global coverage and makes it an independent network that will therefore be more reliable. The network of company E is independent of the grid, because they deliver batteries for the modem that will last for multiple years. Company E filed for an application to have their own frequency spectrum so that they can have full control over their connectivity which is a major advantage compared to other players in the market. Company E's main activities involve getting their infrastructure operational, sorting out legal requirements related to launch and the frequency spectrum and finally with getting launching customers onboard. Company E has a team that is business minded and already has experience with telecommunications. They have a valuable personal network that resulted in a partnership with a venture capital firm. Finally, company E also cooperates with ESA on their current R&D activities developing the technology required for operating their satellite network.

6.1.5.2 Market entry strategy

Company E aims to create an environment optimal for a technology push in the mass market. They want to accomplish this by building the complete value chain themselves and setting the price of their product low, making it more accessible and less risky for their target customers. Simultaneously, they are working with launching customers so that they can gather enough financial resources and demonstrate their technology in the market. The market entry strategy of Company D is summarized in Table 6.14.

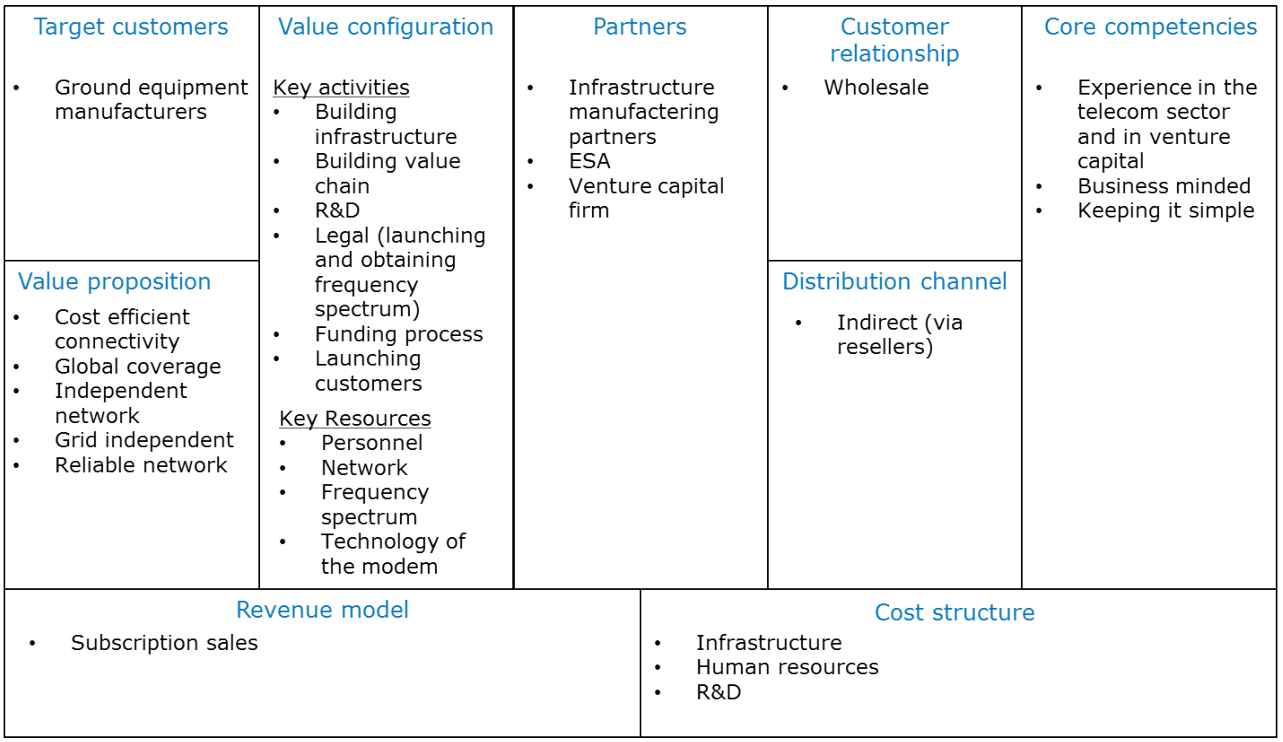

FIGURE 6.10: The business model canvas for company E.

TABLE 6.14: Entry location, entry timing and entry mode of company E

Entry decision	**Company choice**
Entry location	Earth observation
Entry timing	Diversified early follower
Entry mode	• Indirect model • Launching customer

6.1.5.3 Market entry barriers

The market entry barriers which company E encountered and their response actions taken by which they successfully overcame the barrier are listed in Table 6.15.

TABLE 6.15: Entry barriers and reaction to them of company E

Market entry barrier encountered	**Company reaction**
High start-up costs	• ESA cooperation • Launching customer • Venture capital partners • Relatively simple infrastructure
Risk averse investors	Personal network
Risk averse clients	Lower the risk by setting a low price
Long term institutional budget	Focus completely on the commercial market

6.1.5.4 Influence of policy instruments

Company E used the following policy instruments:

- R&D funding by ESA

Company E was able to get a lot of funding from their personal network and were not granted any other policy instrument. Company E specifically mentions that government factors were essential in their case as the Dutch government has a policy that makes satellite launching for Dutch companies much cheaper compared to other countries. Furthermore, the Dutch government is investing a lot of effort in lobbying for obtaining the frequency spectrum which company E considers as one of their most valuable assets.

6.1.5.5 Concept relations

The interviewee was asked if he or she thought that there was a relation between the company business model and the market entry strategy, the policy instruments and the market entry barriers. Results are shown in Table 6.16.

TABLE 6.16: Concept relations in the case of company E

	Entry strategy	**Entry barriers**	**Policy instruments**
Business model	✓	✓	

Company E aligned their business model to their market entry strategy and the market entry barriers. Company E first has to build the whole value chain so that they can apply the business model they have in mind. Company E diversifies itself by using the indirect business model. In order to be able to have a business model suited for the mass market, company E needs to offer their service for an affordable price. Company E states that their business model deliberately does not rely on policy instruments, as they do not want to wait for long processes. Finally, the interviewee mentioned that it is surprising that competition factors are not included in this analysis.

6.1.6 Company F

Company F was founded in 2016 as a spin-off of a Chinese company that was founded in 2007. Company F currently has 8 employees and is led by an engineer with many years of experience in the space sector. Company F still has relations with the company in China but this can be seen as a partnership relation as company F is an individual company. Company F aims to offer earth observation services complementary to the existing earth observation services based on a small satellite constellation. Company F wants to make use of different and less frequently used sensors to provide different data so that it will be able to offer a refinement of the existing earth

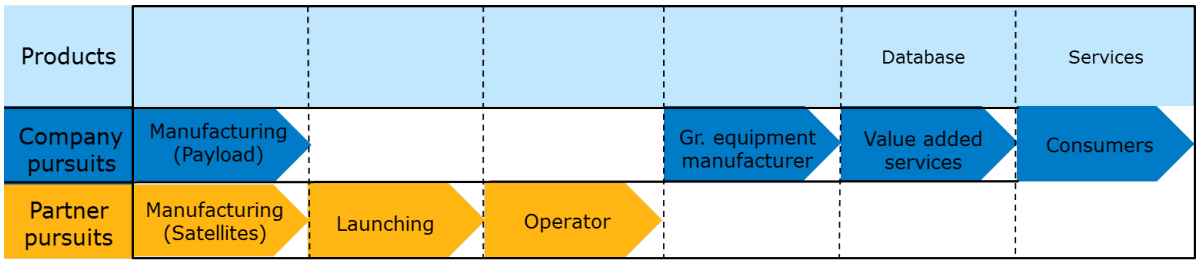

FIGURE 6.11: This figure shows that Company F is able to perform activities on all levels of the space value chain. Company F manufactures their hardware together with a partner, the partner takes care of launching and operating the space hardware but company F manufactures and controls the ground equipment. The final product of company F is a service based on space data which is ready for use to consumers. Company F is not positioned somewhere in the space value chain but covers all levels of the space value chain.

observation data. In the past years, China has invested a lot in their space manufacturing sector which resulted in the capability of China to build state of the art space systems. In contrary, China is less capable in data processing and applications. Therefore, the Chinese company wanted to have a spin-off in Europe which would focus on the downstream data processing and applications. Simultaneously, the Chinese market is quite inaccessible for European companies, so partnering with a Chinese company is advantageous for a European company as it gives you access to a huge potential market. Figure 6.11 illustrates which part(s) of the space value chain involves the activities of company F. Company F will develop and produce the payload, and will be the final service provider while having access to the Chinese satellites and launchers. Company F operates in the partnership model and will initially focus on the Chinese market. The products of company F are currently in the research and development stage.

6.1.6.1 Business model canvas

The business model canvas of company F is presented in Figure 6.12. Company F expects most of their customers to be active in the maritime or air traffic sector. Their service should allow their clients to understand in more detail what is happening in real time to their objects or activities of interest. Company F tests if commercially available components would be suitable for use in space instead of developing everything from scratch so that they are able to constantly innovate their infrastructure for a reasonable cost. Company F has a partnership model thus network and supply chain management are important activities. As company F is the service provider but closely cooperates with space hardware manufacturers, company F is able to offer end-to-end missions. Company F considers business case assessment and design as one of their core competencies next to data processing and system engineering for payloads. The partnership with the Chinese company gives company F an unique advantage of having access to the Chinese infrastructure and market. Company F has a customization strategy and wants the customer requirements to serve as the starting point for their product development. Although they have

access to the Chinese commercial launchers for a reasonable price, launching is still a major cost in their business model.

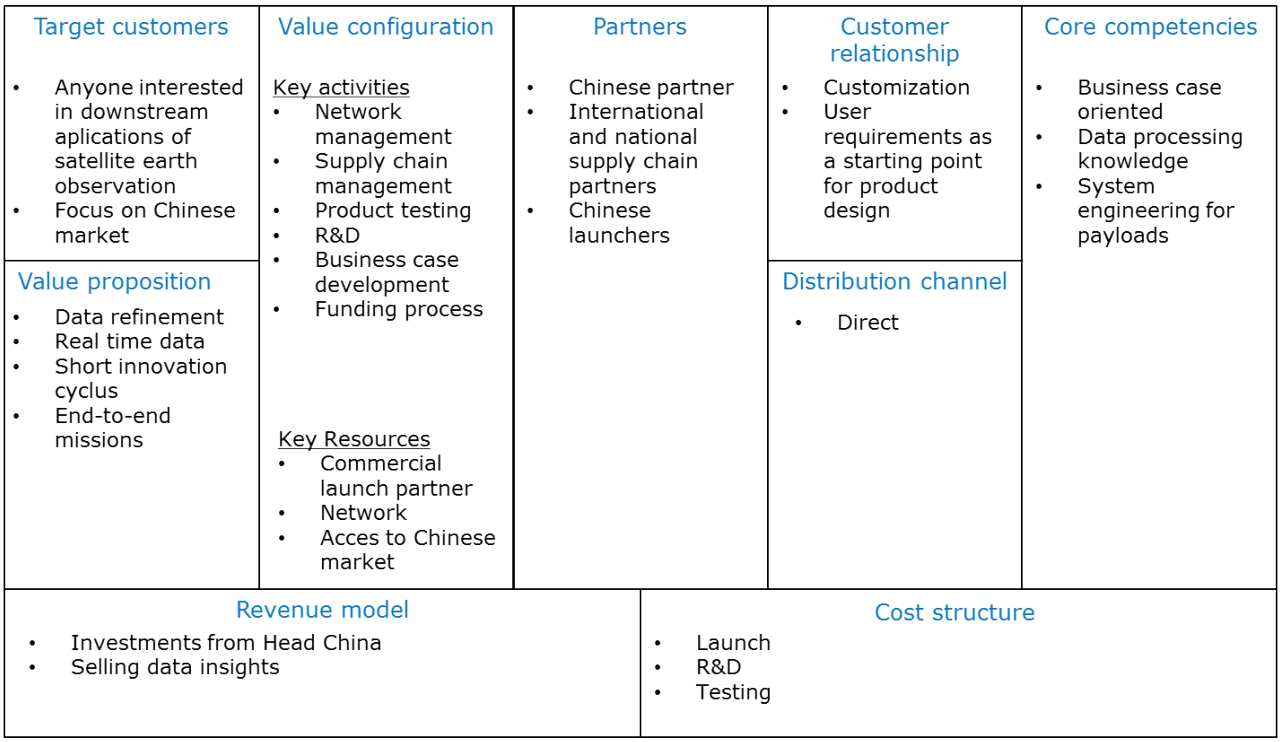

FIGURE 6.12: The business model canvas for company F.

6.1.6.2 Market entry strategy

Company F enters the market together with an experienced partner in space infrastructure (strategic alliance). The Chinese market is not easily accessible for foreign companies while the Chinese themselves do not posses enough knowledge about downstream services, resulting in a large underserved market (market pull). Company F hopes to diversifies itself by focusing on real time earth observation. The market entry strategy of Company D is summarized in Table 6.17.

TABLE 6.17: Entry location, entry timing and entry mode of company F

Entry decision	**Company choice**
Entry location	Chinese earth observation
Entry timing	Diversified early follower
Entry mode	Strategic alliance

6.1.6.3 Market entry barriers

The market entry barriers which company F encountered and their reaction by which they successfully overcame the barrier are listed in Table 6.18.

TABLE 6.18: Entry barriers and reaction to them of company F

Market entry barrier encountered	**Company reaction**
High start-up costs	• Government investment • Partner investment • Only manufacture payload yourself
Complex technology	Choose partner model
Distrust against Chinese partner	• Educate people about the opportunity • European independent company
Fierce competition in earth observation market	• Focus on Chinese market • Offer a complementary service

6.1.6.4 Influence of policy instruments

Company F used the following policy instruments:

- WBSO
- Situated in the ESA Business Incubator Centre (BIC)

6.1.6.5 Concept relations

The interviewee was asked if he or she thought that there was a relation between the company business model and the market entry strategy, the policy instruments and the market entry barriers. Results are shown in Table 6.19.

TABLE 6.19: Concept relations in the case of company F

	Entry strategy	**Entry barriers**	**Policy instruments**
Business model	✓	✓	

The entry strategy affects the business model as company F is mainly focused on the Chinese market. Their diversification strategy resulted in a business model that uses customization as the starting point. Furthermore, the formation of a strategic alliance with a Chinese partner which brings upstream and downstream together is chosen here as reaction to the entry barriers.

6.2 Identified problems in the Dutch space sector

During the interview general problems were discussed regarding government involvement in the Dutch space sector. It should be noted that this part is solely a bundling of all discussed problems and should not be mistaken for a shared vision of all the companies included in this research. These problems are contextual conditions for the Dutch space sector which should be taken into account when interpreting the results of this research. The next Chapter will discuss

the findings presented in this Section and will relate them to the concepts of interest (business models, entry strategies, entry barriers and policy instruments).

1. The Dutch Space Office (NSO) roadmap was mentioned multiple times. If a Dutch company would be looking for national funding, it should first turn to the NSO which will review the business proposition based on their roadmap. The NSO roadmap is a long term strategy for the Dutch space sector. Based on the NSO roadmap, budget allocations are done for multiple years, resulting in little room for new and creative ideas as these generally do not fit in long term strategies. When the proposition in question does not fit the roadmap, funding by NSO is ruled out and therefore many creative ideas might not stand a chance. New comers must be at the right time and the right place to secure a part of the NSO funding as the topics eligible for NSO funding will be determined for multiple years. The available financial resources for the space sector lack flexibility because of this pre-determined long term budget allocations.

2. In order to be eligible for large ESA contracts, you need a track record with ESA leaving not much room for ambitious newcomers.

3. Currently, most policy instruments focus on financing the R&D phase of space activities and do not take into account the later phases (market entry, commercialization and scale up phases). There are general instruments available for this, however space companies stand no chance for these policy instruments as there will be companies from other sectors that will always be able to provide business cases that are less risky. However, ESA and NSO are developing policy instruments that take into account the later phases as well. It was mentioned that, in the case of small satellites and measuring devices, for the application to some policy instruments it is already required to provide a solid business case.

4. The Dutch ministry of economic affairs is the leading department for the policy instruments in the space sector. They are currently tearing down the revolving funds and are focusing more on beneficial tax instruments. At the moment there are not yet many investors that finance start-ups (both early and late phase). Removing the government revolving funds while not having many alternatives at the moment worries space entrepreneurs.

   This won't be enough to get a (space) company to the market.

5. Within ESA there are public procurements, but the general feeling is that companies from other European companies can make a better offer since they can propose lower prices as their governments are financing them. This makes it harder for Dutch companies to win a public procurement of ESA. (e.g. Galileo project has a complete Spanish crew). There should be a level playing field but this appears to be not the case for the Dutch companies, but this is hard to prove.

6. The Netherlands has an over-return in the geographical return policy of ESA which is all coming via ESTEC, so as a small Dutch company you stand a smaller chance in becoming a supplier for ESA projects. There is the possibility to become a sub-contractor to another country but this is also a small chance as everyone prefers a partner in their own country when available. Geographical return policy furthermore makes it impossible for natural market selection to happen. Criteria for partner selection are not just based on price and quality.

7. The Dutch government communicates towards the general public that the Netherlands is, and aims to remain, in the top of the most innovative countries. The NSO policy goals are not as innovative as one would expect from top innovative countries. This can be explained by the lack of focus in the NSO policy goals: quote: 'there are so many priorities and therefore, nothing is a priority'. Finally, in order to be top innovative, a larger budget would be required which is not available for the NSO.

8. Many Dutch national policy instruments require that you match the capital received with 50 %. Given that getting funding for a space start-up is not easy, looking for (a lot of) funding takes up a lot of time and is one of the reasons why the time to market is so long for space companies.

9. Applications for policy instruments are too complex and slow which make them not so accessible. (e.g. often grant advisors are required). Even the regional grant decision taking can take about six months, this is too slow for a fast developing sector.

10. The government is conservative when it comes to being a launching customer while funding from private parties is still difficult in the Netherlands. The Dutch government waits until the market will develop itself, which is slow compared to foreign countries.

11. There is a clear customer need for innovative downstream applications of space technology. At the moment there is investment for the development of innovative applications that use the already excising space infrastructure as this is less risky. However, the growth of and innovation in the downstream segment will stagnate when there is no innovation in the upstream segment.

12. The Dutch space budget is going to ESA which is not contributing to disruptive innovative companies. ESA is too slow and too bureaucratic, being a cultural mismatch with most young innovative companies. The boundary conditions and the screening processes related to ESA applications are not compatible to disruptive innovation. You must be a perfect company having a low risk business case before you would stand a chance for receiving national funding. Therefore, it seems like failure is not an option for Dutch space start-ups while this can never be prevented.

13. As a European space prime, it is not easy to design a supply chain that is able to supply high quality components while being price competitive as compared to foreign space markets. This is problematic for the export activities of European space companies, which, in its turn, makes foreign space markets hard to enter for European companies.

14. The Dutch government does not communicate the Dutch successes realized by space technology very well to the general public. Therefore, the general public is not aware of the usefulness of space technology for society.

15. The institutional space market is said to be a "displacement market" instead of a "growth market" meaning that a competitor can only increase its market share if the market share of another competitor decreases. This is generally what happens when large incumbents are very powerful. Because of this situation, natural competition can not be accomplished.

6.3 Cross case analysis

6.3.1 Company profile

The company profiles were compared to each other using the concepts presented in Section 3.5.1. The results can be seen in Table 6.20.

The companies included in this research identify themselves more with new space than with traditional space. Company B relates the most to traditional space from all companies and stated in the interview that it identifies itself as a traditional space company that has recently started to shift focus on new space activities. This seems consistent with the results presented in Table 6.20. The walk before run strategy is the least scored concept among the companies included in this research. Company A started with selling equipment and sub-systems and company C with cansats while other companies (intend to) immediately bring their finalized products to the market. While many companies received grants from the government, there was no government ownership or investment among the interviewed companies.

6.3.2 Business model and market entry strategy

When comparing the interview results of all six cases with each other for the concepts business model and market entry strategy, some similarities can be found which are listed in Table 6.21, categorized per variable.

Classic primes would once work for their national/European government. In contrast, all companies indicated that they have customers all over the world. Furthermore, the commercial market is growing and all companies are interested in gaining market share in the commercial market. Multiple companies indicated that they will not focus on the institutional market, as

TABLE 6.20: Scoring the companies for various characteristics related to new and traditional space

	A	**B**	**C**	**D**	**E**	**F**
New space						
Company culture						
o Young in Age	✓	✓	✓	✓	✓	✓
o Walk Before Run	✓		✓			
o Vertical Integration	✓		✓			
o Flat Organization	✓	✓	✓	✓	✓	✓
o Privately Held	✓	✓	✓	✓	✓	✓
Technology						
o Technology Development Focus	✓	✓	✓	✓	✓	✓
o Novel Offerings	✓	✓	✓	✓	✓	✓
Markets and Offerings						
o Consumer Focused	✓		✓	✓	✓	✓
o Specialized Products and Services	✓	✓	✓	✓		✓
o Service Offerings	✓	✓	✓	✓	✓	✓
o New Market Creation	✓	✓	✓	✓	✓	✓
o Uncertain Regulatory Environment	✓		✓	✓	✓	✓
o Alternative Approach	✓		✓	✓	✓	✓
Matching (%)	100	62	100	85	77	85
Traditional space						
Company Culture						
o Government Ownership or Investment						
o Large Supplier Base		✓				✓
o Hierarchical						
Markets and Offerings						
o Obscure Pricing		✓				
o Low Sales Volume		✓		✓		
o Low Growth						
Matching (%)	0	50	0	17	0	17

it would be too slow. Interesting is that all companies have organized their business model in a way that upstream is combined with downstream. Therefore, all companies are (not exclusively) service providers. Companies B and C do not exclusively focus on space hardware, but also sell other products/services in other industries. Companies A, B, C and D serve both institutional clients and commercial clients and are therefore classified as hybrid business models. Cost efficiency is an important theme over all the cases, as the companies produce products or services that are affordable for customers outside the institutional market. ESA certification was once a prerequisite for sales of space infrastructure, but for the commercial market this certification is not required.

When looking at the value proposition, only the product of company B has its direct application in space while all other products/services serve direct needs in the terrestrial markets. When comparing key activities no clear similarity was found over all the cases. A potential explanation for that might be that the entry locations (e.g. the markets) are very different for all the

TABLE 6.21: Similarities in business model (BM) and market entry strategy over all six cases

	Companies					
Similarities	**A**	**B**	**C**	**D**	**E**	**F**
BM - Target customers						
International customers	✓	✓	✓	✓	✓	✓
Focus on commercial clients	✓	✓	✓	✓	✓	✓
Institutional business is too slow	✓		✓		✓	✓
BM - Value proposition						
Value chain integration (upstream and downstream are coupled)	✓	✓	✓	✓	✓	✓
Technology miniaturization	✓		✓	✓	✓	✓
Cost efficiency	✓		✓	✓	✓	✓
ESA certification is not a requirement for commercialization	✓		✓	✓	✓	✓
Serves direct needs in terrestrial markets	✓		✓	✓	✓	✓
BM - Key activities						
-						
BM - Key resources						
Network	✓	✓	✓	✓	✓	✓
BM - Partners						
ESA	✓	✓		✓	✓	
BM - Customer relationship						
Customer education is inevitable to deal with risk aversion	✓		✓	✓	✓	✓
BM - Distribution channel						
Direct	✓	✓	✓	✓		✓
BM - Core competencies						
Engineering core competencies	✓	✓	✓	✓		✓
BM - Revenue model						
Service provider	✓	✓	✓	✓	✓	✓
Serve multiple industries		✓	✓			
Hybrid business model	✓	✓	✓	✓		
BM - Cost structure						
Human resources cover a large share	✓	✓		✓		
Entry strategy						
Don't compete with large incumbents	✓		✓	✓	✓	✓
Entry together with (launching) partner		✓	✓	✓	✓	✓
Niche strategy		✓	✓	✓	✓	
Pioneer or early follower	✓	✓	✓	✓	✓	✓

companies included. Within key resources however, network was mentioned multiple times as being very important. This probably relates to the distribution channel, which is most of the time direct as the space companies always have to educate their customers and potential investors on their products. The technology is complex and expensive and therefore customers and investors will have to trust you as a space company. When comparing partners, ESA is mentioned multiple times. While ESA has many large projects for which it chooses large incumbents as their partners just like they did for many years, ESA appears to be open towards smaller and newer companies as they will do small projects or R&D activities with them. Finally,

most companies stated that specific engineering knowledge was definitely a core competency for them.

With regard to the entry strategy, when looking at the entry location we see that the companies are operating in different markets. However, except for company B the companies do not compete with the large incumbents but find a different market instead. The incumbents tend to be oriented to the institutional market and to the large infrastructure projects. Except for company B, the companies provide miniaturized infrastructure products and are more oriented towards the commercial market. The entry timing is in all cases an early stage, either as pioneer or as early follower. This makes sense as the commercial space market is still quite underdeveloped so all entrants would be first movers at this moment. Finally, the entry mode involves in most cases a certain partner, either in a strategic alliance or as a launching customer. The only exemption is company A for which no partners were available at that time and they choose a technology push approach which makes it hard to find a launching customer.

6.3.3 Entry barriers and policy instruments

Entry barriers and policy instruments were topic of discussion in the interviews as they were identified as moderating variables in this research. The results will be presented in the following Subsections.

6.3.3.1 Entry barriers

The entry barriers specific for the space industry that were found in literature were discussed in Section 3.7. All entry barriers were recognized by the interviewees. The companies included in this research were very creative with overcoming these entry barriers as described in the results per company. Table 6.22 shows a summary of all encountered entry barriers.

From Table 6.22 it looks like some companies encountered more entry barriers than others. It should be noted that these results are very subjective as some interviewees would identify more barriers than others. This could have various reasons among which perception of barriers, memory of barriers, understanding of the concept of entry barriers. Furthermore, the content in Table 6.22 is constructed based on how the interviewees phrased the entry barriers and the interviewers interpretation (although the results were checked by the interviewees). All companies overcame all the encountered entry barriers in some way as described in the result Sections (with exemption of the long term institutional budget which company C did not overcame).

All companies encountered the barrier of high start-up costs which is inevitable when working with highly complex technology. Company B, D and F did not mention the long term institutional budget as an entry barrier which is not surprising as company B and company D both have many institutional customers and company F is more oriented towards its Chinese partner.

TABLE 6.22: Entry barriers encountered

Market entry barrier encountered	**A**	**B**	**C**	**D**	**E**	**F**
High start-up costs	✓	✓	✓	✓	✓	✓
Long term institutional budget	✓		✓		✓	
Market competition						✓
Finding qualified personnel		✓				
Production partners hard to find	✓					
Complex technology	✓					✓
Long development time			✓	✓		
Long return on investment time				✓		
Risk averse investors			✓	✓	✓	
Risk averse clients			✓	✓	✓	
Competition of Dutch research institutes				✓		
ECSS certification				✓		
Competition of the large incumbents	✓	✓		✓		
Distrust against the company itself						✓
Total	5	3	5	8	4	4

Company F mentions that they experience fierce competition in the earth observation market. The earth observation market is more developed when compared to for instance the market for sounding rockets. Company F is an early follower and therefore experiences more competition. Finding qualified personnel is something that was mentioned only by company B as a barrier. Many companies however did mention that qualified and specialized personnel is very scarce. Production partners hard to find was the case for company A which was a pioneer in the small sat market. Complex technology was mentioned by company A and company F as an entry barrier, it requires multiple years of R&D before you have a minimum viable product and also you need many partners and specialists which are often hard to find. Thus some entry barriers are very related or similar to each other. Also, the complex technology barrier is probably very related to the long development time which is a result of R&D efforts but also a result of investors and clients that are very risk averse. If there is no easy access to financial resources, the development time is automatically longer. The long return on investment time can be related to the high start-up costs in combination with the specialized market space companies are operating in. The market is (still) small and therefore it takes longer to have a substantial return on investment. Competition of Dutch research institutes was identified as a barrier by company D which makes sense as they operate in the same market. ECSS certification was also only specifically mentioned by company D. This could be because they work closely together with ESA so come across the ECSS certification often. However, most companies overcame the ECSS barrier by miniaturizing their technology. Multiple companies do indicate that they had to find a way to cope with the competition of large incumbents. This mostly resulted in choosing a niche market strategy. Company B is the only company that actually competes with the large incumbents. Company B was active in the space market for already a long time and have a wide network which makes it possible to compete with the large incumbents. Finally,

distrust against the company itself was relevant for company F alone as they are a spin-off of a Chinese company and they were distrusted for their Chinese roots.

Entry barriers that were not topic of extensive discussion in the interviews but were found in literature are discussed below. Dual use nature, this was discussed as being a problem however non of the companies included in this research are producing dual use products(e.g. small sats are not dual use). Making it hard to be competitive for the whole lifetime of a space product since this has to be very long in order to be profitable was also found in literature as an entry barrier. However, most of the companies produce miniaturized products that do not qualify for ECSS standards so are less costly to replace. The replacement of the space infrastructure is foreseen in their business model, they even use it in their business models, making it an advantage as they can provide a quote:'short innovation cycle'. Furthermore, the high degree of vertical integration leaving no room for equipment suppliers was not relevant within this research as all companies were primes themselves. Finally, access to launchers is an entry barrier found in literature as well. All companies overcame this barrier in various ways, company A became a launching broker themselves, company B produces their product on behalf of a launcher, company C develops launchers, company D does not offer launching as a part of their service, company E works with a launching broker and company F has access to Chinese launchers. These solutions to launching were incorporated in the business model from the beginning.

6.3.3.2 Policy instruments

Section 3.6 described all policy instruments available for the companies. An overview of all the policy instruments that the sample of this research used is provided in Table 6.23.

Table 6.23: Policy instruments used

Policy instrument used	**A**	**B**	**C**	**D**	**E**	**F**
European Commission instruments	✓		✓			
ESA instruments	✓	✓		✓	✓	✓
NSO grants						
National fiscal policies				✓		✓
Regional grants			✓			

The European Commission instruments that were granted were the Horizon 2020 grant or the predecessor of this grant (FP7). Other EC instruments like COSME or ESIF were not mentioned by the interviewees. Multiple companies work with ESA in some way: ESA contracts, an ECSS certification programme, a research grant. Also one of the companies is situated in the ESA Business Incubator Centre and another company mentioned that they have a second office which they choose because it is close to ESA. On the national level, company A was the only one that received an NSO grant (PEP). The grant in question does not exist anymore. Some companies make use of the fiscal policy called WBSO, which they find very useful. Company C was the only

one that mentioned a regional grant. Regional grants are not very obvious for space companies as they usually offer lower amount of funding compared to European or national grants. The interest in sounding rockets is very underdeveloped in Europe explaining why it is hard for company C to get national or ESA funding.

The data gathered in this research covers numerous topics and therefore provides a general insight in the behaviour of new entrants in the commercial space market. In order to get good insight in the underlying reasons for choosing specific policy instruments over others, more research needs to be done. However, it can be concluded that ESA is very willing to work with new entrants and that multiple new entrants find their way to a large organization like ESA. The same holds for the Horizon 2020/FP7 programme of the EC and the Dutch national policy instruments like WBSO; new entrants are aware of these policy instruments and apply for it. It was mentioned that ESA contracts are often 100 % funding while the national policy instruments more often 50 % funding explaining why ESA partnerships are popular.

6.3.4 Concept interrelations

A summary of all identified interrelations will be presented in Table 6.24

TABLE 6.24: Concept relations identified

Relation	**A**	**B**	**C**	**D**	**E**	**F**
Business model - Entry strategy	✓	✓	✓	✓	✓	✓
Business model - Entry barriers	✓	✓	✓	✓	✓	✓
Business model - Policy instruments		✓		✓		

All companies indicated that they see a relation between their business model (BM) and their market entry strategy and between their BM and the entry barriers of the commercial space industry. The details of the relations were described in prior Sections. The relation between BM and strategy appears to be mutually dependent as changes in strategy would lead to changes in BM and vice versa. Company B and D indicated that their business model has a relation to policy instruments which can actually be explained by their entry strategy (launching customer is ESA). Company B and D both entered commercial space with ESA as a launching customer and are therefore much more oriented towards the institutional market compared to the other companies.

Chapter 7

Discussion & Conclusion

7.1 Discussion

In this Chapter the results will be discussed and conclusions will be presented per research question. Furthermore, limitations and future recommendation will be discussed as well.

7.1.1 Research question 1

What are the characteristics of and trends in the European space manufacturing industry?

The characteristics that were found are:

- Very concentrated both in terms of industrial groups as in space industry employment (3.4)
- Sales is mostly to European customers (77 % of the total sales in 2016)(3.4)
- European sales is mostly to public customers (68% of total European sales in 2016) (3.4)
- Europe does not have an independent space sector (3.2.3)
- Europe is a global leader in earth observation systems (3.4)
- European players have a strong market position in the satellite constellation segment (3.4)
- There appears to be a finance gap for space start-ups (3.5).

Multiple trends were discussed, the most important ones being:

- Increased market entry
- New market development
- Innovative business models

7.1.2 Research question 2

What are the business models of space start-ups and how are they related to successful market entry in European commercial space?

As described in Chapter 4, the business model canvas was used to analyze the business models of the companies. The results were presented in Chapter 6. Comparing the business models found in this research to the descriptions of business models applied by space companies in literature is hard as in literature there is no single definition of the concept business model. However, a more qualitative comparison can be done.

A sort of PPP can be recognized in the models applied by Company B and company D (ESA as a launching customer). The PPP's as described in Chapter 4 were not recognized in the models of the companies included in this research (The classical institutional business model, the government owned, company operated (GOCO) model and the concession model). All companies included in this research are owners of their company and do not have the government as a stakeholder. Multiple interviewee's however stated that they were hoping that the Dutch government would adopt a launching customer model as well.

The mature private business was described in Chapter 4 as if it is a business model in itself to be fully independent of the government. The mature private business model is not a relevant model for private companies in the commercial market as the starting point is this model for these companies. This model can therefore not be used to distinguish between private companies. A pure value added service model is not applicable in this research as well since the companies selected had to be primes in the space manufacturing industry. All companies are however service providers, but not exclusively.

Vertical integration is a model that was identified in company A and C. Company A and C are both pioneers in their market and the customer need was not yet developed. They had a technology push approach while for instance company B and D were also pioneers but there we can see a situation of market pull. Potentially for that reason, company B and D were able to find partners, and company A and C were not and choose to be vertically integrated.

The hybrid model concept can be recognized with company A, B, C and company D. Those companies have both institutional and private clients. Company A is much more focused on the commercial segment while company B, and D are more clearly more focused on the the institutional market. B and D have (multiple) contracts with ESA and that is an important part of their business model.

A new finding that follows from this study is the end-to-end model, being the combination of manufacturing space infrastructure and providing value added services. All companies included in this research manufacture and own space infrastructure and provide services based on this infrastructure. In the business model design, the investment cost of the infrastructure is accounted for in the service that the companies provide. This is a new concept and this is conflicting with

the general explanation of the space value chain were different actors were thought to be responsible for different levels in the value chain. In this situation, only one actor/company is controlling the whole value chain for its product/service. Business models of space companies that are looking to enter the commercial space market should have a profitable business case in order to realize successful market entry. Integrating upstream with downstream is a way to realize a profitable business case in the commercial sector. This finding can be related to the design element 'governance' which was related to business model innovation. The end-to-end model can be seen as governance innovation as it changes who is performing what kinds of activities.

It is however incorrect to describe a specific business model in such a general way as is now done for the end-to-end model. It was discussed how the complexity of business models and the interplay of various components of business models can not be caught in just a 'type'. Naming a 'type' of business model is however very convenient.

Furthermore, innovative elements in the business models that can be discovered in this study include the concept of launch brokerage (becoming a travel agency for e.g. satellites) and the short innovation cycle by using COTS technologies (using the vulnerability of space hardware as an advantage). Characteristics that were related to new space ((Hobby space, 2017)) can also be recognized in the business models. The low cost focus, the innovation focus, the focus on consumer markets, the incremental development and the small teams are all facets related to new space which can be recognized very clearly in the business models of the researched companies.

It can be concluded that all companies in this research choose the end-to-end business model. As there seems to be a certain trend in the business models, it can be carefully concluded that this type of business model could relate to successful market entry. This research does by all means not provide argumentation that business models would not be related to successful market entry in the commercial space industry. The next research questions will also discuss if specific choices within the business model can be related to successful market entry (determinants).

7.1.3 Research question 3

What are the market entry strategies of space start-ups and how are they related to successful market entry in European commercial space?

From literature there were no market entry strategies identified that were specific for the commercial space industry. A finding from this study was that most companies seek some kind of strategic alliance (among which the launching customer strategy) as a market entry mode. Generally, firms form strategic alliances when they are in emerging or competitive surroundings or when the company in question is focused on innovative technology (Kathleen M. Eisenhardt, 1996). All companies included in this research are technical pioneers or early followers which

have entered emerging markets. They avoid the highly competitive and concentrated classical space market but instead focus on a niche market. However, the earth observation market is for instance already a very competitive market. This explains the choice for a strategic alliance. Company A is an exception, as there were no suited partners available to form a strategic alliance with. The finding regarding market entry is thus not surprising and consistent with existing literature. Chapter 3 also discussed that there would be a finance gap for space companies. For that reason it is also very logical that start-ups would look for partners that are able to help them through the commercialization phase.

Company A and C choose the technology push strategy in the context of an underdeveloped market and are consequently both vertically integrated. These companies both work with minimum viable products (MVPs) in order to keep the costs down. This is probably the hardest strategy as they have to develop the market themselves. Company A was granted multiple policy instruments and company C found a launching customer. These factors could potentially have been essential for the survival of company A and C. Company B, D, E and F all choose the market pull strategy. Company B and D were 'pulled' by the institutional market and company E and F are responding to the market needs of the commercial market. B and D were able to start with ESA contracts, E found multiple private investors that also recognize the market potential and F entered the market in a strategic alliance with a Chinese partner. A market pull in combination with a first mover timing requires deep understanding of the market that a company is trying to enter. This was both the case for company B and D which were founded by very experienced persons in the space industry. Company E and F are early followers that diversify themselves and they consequently face tougher competition in the market that they are trying to enter.

In general, the market entry strategy for all the researched companies seems to be more unambiguously than the business models. Finding a reliable partner seems to be essential when entering the commercial space industry. Furthermore choosing a niche strategy also seems to have been essential for successful entry. The market entry strategy could therefore be related to successful market entry. However, it seems like multiple factors are interrelated and not just the market entry strategy is related to successful market entry. Specific facets of business models can be recognized like network and experience which helped company B and D to identify the business opportunity. But also the choice for an MVP which is part of the value proposition seems to have been a key decision for company A and is very probable to have contributed to successful market entry. Then, going for a niche market could both be an entry strategy (entry location) and a component of a business model (customer segment). The results thus provide argumentation that both market entry strategy and business models can be related to successful market entry in the context of the commercial space industry.

7.1.4 Research question 4

What are the entry barriers that space-start ups encounter and how do they influence successful market entry in the European commercial space industry?

Entry barriers are literally barriers to enter a market and therefore need to be overcome by a market entry strategy in order to successfully enter a certain market. Entry barriers that are specific for the commercial space industry were identified and described in Chapter 6.

All interviewees stated that the presence of market entry barriers influenced the decisions they made regarding their business model and market entry strategy. This can be clearly recognized in the detailed descriptions of the entry strategies and business models per company. The ways by which companies overcame the entry barriers are often embedded in their business model or entry strategy. As an example, high start-ups costs and ECSS certification were among others countered by miniaturizing technology which is part of the value proposition. Competition of the large incumbents was solved by entering a niche market, part of the entry strategy or business model. The risk adversity of both clients and investors can be (partly) solved by working with a launching customer (entry strategy) as this will provide the opportunity to demonstrate the products/services. Market entry strategy is often related to market entry barriers but business models are not. Business models are accused of not taking into account external factors. For the space industry, this seems to be not the case as entry barriers seem to be taken into account when designing the business model. This could be specific for the space industry as entry barriers are very present here so it would not be realistic to not account for these market factors when designing the business models.

From the results of this study, it can be argued that entry barriers influence successful market entry as they are taken into account when designing the market entry strategy and the business model. Vice versa, this provides extra argumentation that market entry strategy and business models are related to successful market entry as they are clearly designed to fit with the market environment.

7.1.5 Research question 5

What are the policy instruments that space start-ups used and how do they influence successful market entry in the European commercial space industry? Chapter 6 identified and described the policy instruments that space start-ups used.

The Horizon 2020/FP7 grants, many ESA contracts and the WBSO policy all have in common that they are focused on the pre-commercialization phase. The space industry has some major barriers for market entry so it can be concluded that space entrepreneurs are very vulnerable to the so called valley of death, the funding gap between research and commercial application. The valley of death is a well known problem which leads to a situation where many new and

demonstrated technologies will never reach the market. The problem of the valley of death is especially relevant in technologies that obtain funding for basic research from the government but once they are considered to be "too applied", private investors are needed in order to survive on the commercial market. At that moment, many investors consider the investment still too risky. The public budget for space technology is not sufficient and not intended to get a space technology all the way to commercialization. Multiple companies included in this research indicated that it would be helpful when the government would be launching customer in order to successfully reach the commercialization phase. In other words, some of the respondents proposed a launching customer model in order to cross the valley of death which they currently seem to be facing.

The valley of death can be observed in multiple high tech markets. Murphy et all for instance describes the transitioning from public to private sector financing in the US clean energy industry(Murphy and Edwards, 2003). Furthermore, the valley of death was identified as being the primary reason for preventing the implementation of certain types of new technologies on space missions (Bruhn et al., 2017). Crossing the valley of death is even mentioned at the top of the key issues list of the American Institute of Aeronautics and Astronautics where it is called transition of research into application(AIAA, 2013). The EC acknowledges the existence of an "European valley of Death" which is a major problem since the result is that many manufacturing companies leave Europe and start their business somewhere else(European Commission, 2017d).

The policy instruments in the form of grants do not seem to influence the market entry strategy and the business model. Policy instruments in the form of grants can not be included in the design of the market entry strategy or business model as it is very uncertain if they will be granted and the process of applying appears to be too long 6.2. The launching customer model of ESA definitely influences the market entry strategy and the business model which is explained in the cases of company B and D. The launching customer model is a potential solution to overcome the valley of death. Multiple companies indicated that they hope that the Dutch government would adopt this model as well as this could advance the Dutch space industry. Policy instruments in the form of launching customer models could definitely have an influence on successful market entry as it helps to overcome one of the major barriers of the space industry, the finance gap.

ESA provides a launching customer model but the geo-return policy of ESA makes it hard for Dutch companies to apply for ESA contracts as the Dutch contribution to ESA is relatively low, as explained in Section 6.2. This is especially hard for space companies that are very innovative and do not have an extensive track record yet which is the case for start-ups in commercial space. If a launching customer would be a more 'accessible' instrument this could become part of the business model or market entry strategy of a company and could then probably be related to successful market entry.

7.1.6 Research question 6

Which similarities can be identified as determinants in the business models and market entry strategies of successful start-ups operating in the European commercial space industry?

The similarities were identified by reference class forecasting in Section 6.3.

The results show that some factors were shared by all companies. These factors can be proposed as determinants for successful market entry in the commercial space industry, however more research is needed in order to validate these determinants. The following factors can be proposed as determinants for successful market entry in the European commercial space industry:

- International market development
- Value chain integration (end-to-end model)
- Being a service provider
- Having a relevant network
- Being able to lower start-up costs

Traditional space used to focus on their national/European market only as space technology was historically closely related to defence applications. But the national public market is too small for innovative space technologies nowadays. Furthermore, export is often limited by dual-use law. Companies included in this research were able to develop an international market as they are not subject to dual-use law and not directly associated to defence applications. This is a huge advantage and it is therefore proposed that a focus on the worldwide market could be a determinant for successful market entry. It was explained in Chapter 3 that many new space companies profit from economies of scale and therefore require a larger market. Many of the respondents are in very specialized and often niche markets. It is known that these types of companies benefit from international market development(Coviello and Munro, 1995). Value chain integration is the second potential determinant for successful market entry. The advantage of value chain integration is that expensive, complex space hardware products will be able to serve a direct need (either terrestrial or in space). This is also an advantage in the communication, being able to explain which problem you will solve instead of explaining the technical details of space hardware. In order to achieve value chain integration, having low production costs is essential otherwise the space infrastructure can not be earned back within a reasonable time. A mean to accomplish this is among other the usage of COTS technologies and working with minimum viable products. These aspects were identified as being related to new space companies in Chapter 3. The third determinant that will be proposed is related to the second determinant and involves being a service provider. The final service that most companies deliver is a product that is easy to work with. It often involves a database or even

a processed data. This greatly reduces the complexity of the product/service you can offer as a space company making it more suitable for a mass market. The fourth determinant that will be proposed is network. All respondents identified this as very important. This determinant is related to the high degree of concentration within the space industry but also to fact that space technology is highly specialized and complex. Both investors and customers need to be educated about the product in question and it is essential to raise trust among these stakeholders. The final determinant that will be proposed is that a company should be able to lower the start-up costs in some way. Otherwise, the risk will be too high meaning that the attraction of investors will be even harder. Furthermore, the market is too limited if the price of your products is very high, then you will be in competition with the large incumbents that serve the public market.

As it was possible to identify multiple potential determinants both within the concept of business model and the concept of market entry strategy, this suggests that business models and market entry strategy are related to successful market entry.

As discussed in Section 4.3.2, research done by Schmidt has proposed driving criteria for new space entrants focused on the business to government(B2G) market. Experience, network and seed investment were proposed as driving criteria(Stefan, 2014). Schmidt proposed the publicprivate partnerships (PPP) as a tool to overcome this criteria but did not provide details of the suggested PPP.

The findings of Schmidt can be related to the findings of this research, although this research does not solely focus on the B2G market, but also on the B2B market. Network was proposed here as a way to overcome the experience barrier and to raise trust. Furthermore, seed funding was not a topic in this research but it is indeed essential in order to overcome the finance gap.

7.1.7 Research question 7

How could the current European policies be improved so that more start-ups will emerge in the commercial European space-industry?

The interviewee's identified problems in the Dutch space sector. The interviewees also did some suggestions for the improvement of policy instruments. Based on the results from both the interviews and the literature review, the following recommendations for the Dutch government can be proposed:

- The conditions for level playing field need to be secured. Government bodies should evaluate the current situation regarding level playing field conditions for Dutch companies.
- Explore the potential of the launching customer model as a Dutch government. The launching customer model has many advantages: advance the space industry by overcoming the finance gap, explore applications of space technology for government use and, if implemented correctly, it should be economically advantageous for the government.

- Address and further analyze the problem of the valley of death. A launching customer model could help to overcome the valley of death but it is probably not enough to solve it completely. For instance, the government could put more effort in being a facilitator between investors and start-ups or in being a facilitator of a relevant network.
- Improve the grant application procedures so that it will be a less complex and time consuming process. Currently the grants might not be as effective as they should be because of this reason.
- Create awareness about the successes and applications of space technology for the everyday user among the public. This could increase the customer need and could therefore drive the market pull effect. Furthermore, this would help to educate the investors as well who's involvement and willingness is much needed to advance the industry.
- The government should clearly articulate their long-term needs, demands and ambitions to the space industry so that business opportunities can be identified and market pull in the institutional market can be increased.

7.2 Theoretical implications

This research has multiple theoretical implications which will be discussed in the next Sections.

7.2.1 The space industry

First, there is no uniform definition of the concept new space. Even leading organizations in the space industry like ESA and NASA do not provide a clear definition on this concept. Furthermore, different words are used to describe new space, e.g. space entrepreneurship, space 2.0, emerging space, private space. This study calls for more uniformity in referring to new space and for more research on the concept new space so that it can be better defined. This research found that current working definitions for new space are recognized by space entrepreneurs. They seem to be appropriate to describe the current activities in the commercial space industry as there were no conflicting results.

This study contributed to literature on the commercial space market by identifying and describing business models, market entry strategies, market entry barriers and policy instruments that are used by new entrants. Literature on these topics in the commercial space industry is still very nascent. It was unclear what kind of business models and market entry strategies new space start-ups choose. This study provides clarification on these topics and identifies a new type of business model which is applied by new space start ups, referred to as the end-to-end model. This model was not described before and goes against the general understanding of the space value chain. When using the concept of business model innovation, the end-to-end model

can be seen as governance innovation. Market entry strategies were characterized by strategic alliances, among which the launching customer model, and niche strategies. When comparing this to literature, it can be concluded these market entry strategies were to be expected for and can be explained for this type of industry.

Furthermore, an important finding of this study is that entry barriers are related to business models and market entry strategies in the context of commercial space. This study shows that entry barriers are considered when designing the business models and market entry strategies. Policy instruments were also related to business models an market entry strategies but only in the case of the launching customer model.

Finally, this study provides argumentation for business models and market entry strategy being predictors for successful market entry in the commercial space industry. In the end, no definitive conclusions can be drawn from this study as it is the first on the topic market entry in commercial space.

7.2.2 Business models and market entry strategy

From this research it can also be concluded that there is no uniform definition of the concept business model, market entry strategy and market entry mode. This research shows that the concepts business model and market entry strategy are related when focusing on the phase prior to actual market entry. Changing a market strategy also requires to change the business model. Some of the components of market entry strategy and business model also seem to be overlapping. The difference between the concepts is anyway hard to define. In Chapter 2 it was discussed that some scholars see the business model as abstract representation of some aspects of a firms strategy, others state that the business model is a reflection of the firm's realized strategy. Also the question rises, what is defined first; the business model or the strategy? From the description of the cases it seems that the design of a market strategy occurs parallel with the design of the business model. Both the concepts influence each other but in the end they have to fit with each other. Therefore, it will be hypothesized here that the process of market entry looks like a design process where different configurations of the concepts are combined until the best combination is reached. It also seems that in this optimization process, the combination is constantly checked with the market factors like policy instruments and entry barriers. The scholars which discuss the relation between strategy and business model do not specifically discuss this in the context of market entry. It should be noted that the scope of this research only considers the phase before actual market entry. In a different lifetime of a start-up, the relation between the concepts might be different. This study thus states that external factors are included in both the design of business models and market entry strategy. This line of argumentation is shown in Figure 7.1.

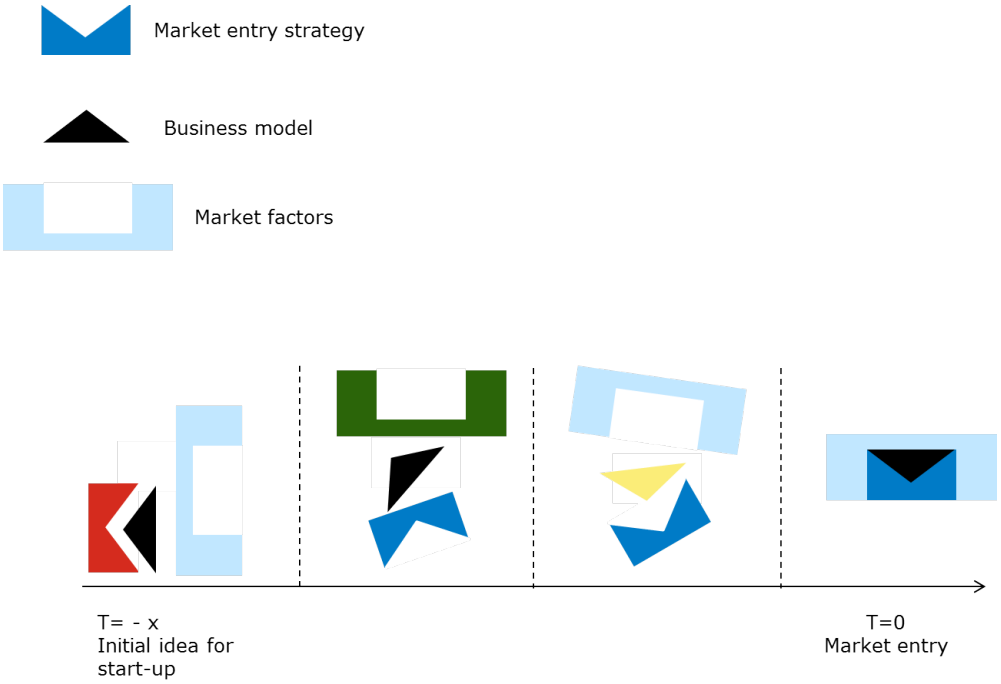

FIGURE 7.1: The process of market entry is described as matching different configurations of market entry strategy, business model with the market factors. The business model and market entry strategy can be changed and the market is dynamic as well, depicted as changing colours. In the end of the process all these components should be aligned and fit with each other in order to enable market entry.

Furthermore, this research uses a single aspect of the business model that was very strongly present to describe the complete concept of business model. This is something that was encountered in the literature review as well (e.g. the concession model, the vertical integration model, the hybrid model). While much argumentation is provided for how complex business models are and how much different components they have, they are still often described by just one word in literature. All the interconnections and different building blocks behind the business model are neglected when describing a business model with just one word. Reasons for this might be that it is very inconvenient to use such an extensive working definition of the concept business model.

Finally, a theoretical implication of this study is that it is prove for how difficult it is to research business models in practice. This calls for a more pragmatic approach to business model analysis frameworks. An extensive model like the BMC suits comparing and describing business models in a structured way (this is why it was used), however, it is not very practical and not much literature can be found that provide complete BMCs.

7.2.3 Successful market entry

This research provides argumentation for the conceptual model as presented in Section 2.3. Business models and market entry strategies can be classified as predictors for successful market entry in the European commercial space industry. A specific type of business model and market entry strategy can be found in this research sample indicating that it could be related to successful market entry. Furthermore, it was possible to identify potential determinants within the scope of market entry strategy and business models. The companies included in this research thus made some similar decisions which is hypothesized to lead to the same outcome, successful market entry. These findings contribute to literature as it provides specific predictors for the commercial space industry, which is a topic not researched in detail before. The findings also contribute to the general theory on successful market entry as the role of business models and entry strategies within this topic was discussed in detail. Finally, these findings also contribute to domestic market entry literature, a topic which has apparently not enjoyed a lot of interest before.

7.3 Practical implications

The proposed determinants can be taken into account by entrepreneurs looking to become a new entrant in the European commercial space industry in order to have a better chance for success. Furthermore, policy makers can use the policy recommendations presented in this study to review the current policy framework. Policy makers can also use the identified determinants in order to develop and review the policy framework so that it can stimulate and facilitate market entry in European commercial space even better contributing to global competitiveness for Europe. Finally, this study provides an overview of the problems encountered in the Dutch space sector which can be used to improve the sector conditions.

7.4 Conclusion

Every research question was discussed independently and conclusions were provided. The most important conclusions will be presented here:

- Answering research question one led to the identification of important characteristics and trends of the European space manufacturing industry that are related to new space (7.1.1). Most notable are: that most sales is still to public customers, that Europe does not have an independent space sector, that there seems to be a finance gap for commercial space companies but that Europe however has a leading position in some commercial space market segments. This indicates that there is still much room for growth of the commercial

sector in Europe. In some segments the commercial space industry in Europe apparently already developed quite well and is very successful. It could be interesting to research the small satellite market or the earth observation market in more detail in order to see how Europe was able to become successful in these specific segments. Finally, it should be researched how many companies are currently entering the European commercial space industry and in which segment they operate, as this is still unknown.

- Answering research question two identified that there is a need for the launching customer model as expressed by the interviewees. Also, the hybrid business model is recognized in multiple cases and a new business model was identified, named the end-to-end model (7.1.2). The end-to-end model could be a specific model for commercial space companies. The end-to-end model is basically earning back the equipment needed to provide a certain service. This is not a very innovative model in itself, it only was not applied in the space industry before. It changes the way one has to view the space value chain, as one actor/company is now able to to be responsible for every part of the value chain.

- Answering research question three identified that a strategic alliance and focus on a niche market is the preferred market entry strategy (7.1.3). The launching customer model here is also viewed as a sort of strategic alliance.

- Answering research question four led to the identification of the most relevant entry barriers (7.1.4). A response to entry barriers encountered is included in the design of the market entry strategy and the business model.

- Answering research question five gave insight into which policy instruments most companies use. From this analysis it was hypothesized that the companies are currently subject to the so called valley of death, inhibiting commercialization (7.1.5). The policy instruments in the form of grants do not seem to influence the design of the business models and market entry strategies much. The launching customer model however clearly influences these concepts.

- Answering research question six led to the proposition of five determinants for successful market entry: International market development, value chain integration, being a service provider, having a relevant network and being able to lower the start-up costs (7.1.6). These determinants should be validated by quantitative research and there relative contribution should be investigated in a larger research sample. Also a control sample should be researched including companies that were not able to successfully enter the market.

- Answering research question seven led to the proposition of policy recommendations (7.1.7).

- The theoretical implications suggest that both business models and market entry strategy are concepts which are related to successful market entry. It is hypothesized that the design

of business models and market entry strategies is a parallel process which takes place prior to market entry. Different combinations of these concepts can be tried and finally when the right combination is found and this is aligned with the market environment, market entry is possible.

- The practical implications provides useful tools to both entrepreneurs and policy makers. It would be useful to measure in some way if increased market entry does really stimulate the competitiveness of the European commercial space industry.

7.5 Limitations

Some limitations can be identified for this study based on its exploratory design(Lynn University, 2017). This research used a small sample size which is common in exploratory studies. Therefore, the results of this study might not be generalizable to a large population. This is probably true for the scientific implications as the space industry has its very specific own characteristics. However, the practical implications of this study were not meant to be generalizable to a larger population, as the small sub segment of the space industry is the topic of interest, and therefore are not limited by the sample size. The title of this study is successful market entry in the European commercial space industry. However, only Dutch companies were included in this research. The problem statement was formulated on a European level, the space industry was analyzed on a European level and also policy instruments and entry barriers were analyzed on a European level. Specific characteristics of the Dutch space industry were presented which need to be taken into careful consideration when interpreting the results for the European commercial space industry. The new space sector in Europe is still young and small and therefore it is assumed that Dutch companies can provide insight into the general dynamics of the European industry, provided that the specifics of the Dutch sector are clearly explained. Furthermore, the fact that this study is exploratory also results in the inability to make definitive conclusions about this topic. Recommendations for future research will be presented in the next Section. Because of that, the deliverable of this study is tentative as more or different policy recommendations might arise from future reasons. Therefore, reviewing current policy instruments should not be done based on solely this research. Furthermore, this study uses a data collection method that used semi-structured interviews and a method of analysis that lacks rigorous standards. This approach fits the objectives of this study but should be taken into account when using the results from this study. Another limitation of this study concerns the dynamic nature of the commercial space industry. As there is mention of an industrial revolution, the results of this study might soon be outdated. This research did not include new businesses that were not successful in their market entry in the commercial space industry which is another limitation as there is no data to compare the results of this study with. Finally, this research concerns for a large part the concept of business models. Describing a business model

of a certain company that successfully entered the market so that other companies can learn from these successes does not take into account the business model implementation which is a difficult process itself ((Osterwalder et al., 2005)). Therefore, knowing all the ingredients of a successful business model and a successful market entry strategy does not guarantee that the implementation of this tools in another company can be successful.

7.6 Future research

Since this will be the first source of data that allows identification of determinants for successful market entry in European commercial space, to my knowledge, further research is required to make a quantitative validation of the correlations discovered in this research. More research needs to be done in order to provide more argumentation for the proposed determinants and in order to build a more specific conceptual model.

Appendix A

Interview questions

Successful market entry

1. Would you say that your market entry was successful? Please explain.
2. Would you classify your company as innovating? Please explain.
3. Would you say your company is a new space company? Please explain.

Business model

1. What is your value proposition? (Which products or services and what value do they add)
2. Which customer segments do you serve?
3. Which distribution channels do you use to reach your customers?
4. How would you describe your relationship with your customers?
5. Which are the key activities and resources you require for the production of your product or service?
6. What do you believe are the competencies necessary to execute the company's business model? The so called core competencies.
7. Which partners do you have?
8. How do you cooperate with your partners?
9. What are cost items in your company?
10. What are the different revenue streams?

Entry barriers

1. What entry barriers did you encounter when you started your company?
2. How did you work around these entry barriers?
3. Is there a relation between your business model and the entry barriers you encountered? (e.g. Have you specifically designed your business model in order to work around these barriers?)

Entry strategy

1. How would you describe your market entry strategy?
2. Is there a relation between your business model and your market entry strategy (E.g. Have you specifically designed your business model to match with your entry strategy?)

Policy

1. Did you use any policy instruments (government support e.g. financial support) that eventually contributed to your successful market entry?
2. Is there a relation between your business model and policy instruments? (E.g. Have you specifically designed your business model in order to benefit from certain policy instruments?)
3. Do you have recommendations for (new) policy instruments (government involvement in the space industry)?

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