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Opportunities and Challenges for Start-up Entrepreneurship in the Space Industry of Finland

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Abstract

The private sector of the space industry has been developing for the last several decades, forming a new period of space exploration. The period is known as New Space and is characterised by cooperation and healthy competition between countries and companies that aim to accomplish own scientific, military, or commercial goals and ultimately achieve a self-sufficient space economy. Recently, more private entities of New Space started to appear in Finland, boosting innovations and attention to the local space activities. Since development of the national space industry is dynamic and more space-related start-ups are expected to emerge in the upcoming years, the research on the favourable factors and problems local entrepreneurs may encounter was conducted. The study had two objectives. The first was to identify possible opportunities and obstacles entrepreneurs could face entering the space industry of Finland, and secondly, to provide recommendations on the obstacles overcoming.

The study was qualitative and had an exploratory purpose. Secondary data was analysed to build comprehension of the space industry, its background and specifics, and to define funding sources and growth acceleration entities available for Finnish entrepreneurs. Primary data was collected through semi-structured interviews with representatives of the Finnish space industry. The sample was chosen purposively to ensure richer insights, and therefore it included Finnish space entrepreneurs, representatives of government, and members of other public sector actors. In total, eight respondents were interviewed. The interview process was finished when data saturation was reached. The study was implemented under interpretivist philosophy, applying inductive approach.

The findings showed that the main opportunities space entrepreneurs have in Finland are public and government support, geopolitics, and the local space community size and attitudes. The obstacles were receiving funding, work organization, network building, and identification of market and customers. Based on the results, recommendation on avoidance or overcoming of the obstacles were provided. In addition, directions for further research on the subject were presented.

Keywords/tags (subjects)

The space industry, entrepreneurship, Finland, start-up, New Space, funding, high-technology sector

Miscellaneous (Confidential information)

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1 Introduction

1.1 Background and Relevance

From the outset of the space industry development, regulation of human activities in space was the domain of governments. Governmental agencies had a centralized control over production and execution of space missions and technology, alongside with provision of space-enabled goods and services (Canis 2016, 1). However, after decades of such setup, centralization was claimed inefficient due to apparent vulnerabilities, such as lack of innovation, and the United States decided to encourage private ownership in order to facilitate competition and further partnership (Weinzierl 2018, 173-176). This decision was an incentive for the legislation change and resulted in introduction of several acts that aimed to support the private sector's involvement into space exploration. Hereafter, the role of governmental agencies began to diminish, leaving more space for private initiatives.

Simultaneously with the regulation shift, scientific discoveries of the twentieth century, the Space Race, and substantial progress in technology fostered commercial interest in cosmos. Private start-ups began to appear, forming another competition, also known as New Space (Datta 2017). This rivalry, unlike the Space Race, is not driven by dominance establishment. It aspires to reach the long-term goal of achieving a self-sufficient and large-scale space economy, ultimately enabling humankind to live and work outside Earth (Weinzierl 2018, 174). In other words, New Space can be characterized as a period of space exploration when private companies and governmental agencies operate within healthy competition and cooperate in order to create innovations and to reach own commercial, military, or scientific objectives.

Although space remains a state dominated industry, the breakthrough of private actors cannot be undervalued. Not only did private spacecraft launches outnumber governmental, but also start-ups such as SpaceX and Blue Origin embodied the ideas of reusable rockets, made launch and construction of spacecrafts cheaper, and elaborated a diversity of space data applications. New Space players proved that the economic potential of cosmos is vast through evolution of neoteric sub-industries and bold projects that were either impossible, risky or out of the counties' interests.

Relevance

In the last few years, five Finnish satellites have been launched into space, decisively turning Finland into a space nation. Three out of five spacecrafts belong to private start-ups, Iceye and Reaktor Space Lab, and have commercial missions. Nonetheless, these young companies are not alone in the dynamically developing industry. Ecosystem of the national space sector contains both established companies such as Space Systems Finland that proved their competences in software development for spacecrafts, and new contributors with innovative ideas and approaches such as Aurora Propulsion Technologies.

The Finnish space sector is expanding, and the local authorities and universities understand the industry's importance and assist its development. In January 2018, the first Finnish comprehensive space legislation was elaborated and signed by the president (Adamowski 2018). The act represents a legally clear system with smooth authorization process and equal obligations that is capable of facilitating competitiveness and expansion of the national space industry, while attracting new actors and investors (National space legislation 2018). Besides, the main public growth accelerator of Finland, Business Finland, devised the New Space Economy program that is dedicated to financing and to helping local space companies to grow. Entrepreneurs can also apply for the recently open European Space Agency Business Incubation Centre to receive additional assistance and funding, as well as participate in competitions and events, such as Slush and Finnish Satellite Workshop, to find probable stakeholders and extend professional networks.

Summarizing, the private sector of the space industry of Finland started actively developing several years ago, letting New Space actors launch their businesses and established companies improve their competences and existing products. The national public sector actively facilitates the growth by introducing new programs and providing financial support. Therefore, the research on exploration of opportunities and obstacles local entrepreneurs can encounter entering the private space sector is reasonable and timeous and is able to bring insights and benefits to entrepreneurs who are planning to operate in this area. The author's personal interest in the space science and technology and the current dynamic state of the Finnish space industry became the main motivators for the research.

1.2 Research Objectives and Questions

The study is aiming to explore business opportunities and obstacles entrepreneurs face entering the Finnish space industry. Thus, the objectives of this thesis are: to examine favourable factors and existing entities that assist Finnish space start-ups in their development; and to define and provide recommendations on how to prevent probable obstacles entrepreneurs encounter when establish private ventures in Finland. According to Salamzadeh and Kesim (2015, 6), receiving funding is a challenge for many start-ups, especially in high-technology industries. Hence, the study is also aiming to describe financial instruments space entrepreneurs can utilize, globally and in Finland. This assumption did not impact primary data collection and analysis.

To achieve these objectives, the following research questions must be answered:

RQ1. What are the options for growth acceleration and financial support available to private entrepreneurs in the high-technology sector, globally and in Finland?

RQ2. Which opportunities and obstacles do private space entrepreneurs encounter in Finland when they establish a start-up?

RQ3. How can the obstacles be avoided or overcome?

These research questions are designed in a manner to initially study means for high-technology start-ups establishment, especially, for space start-ups launch and development. **RQ1** examines the ways of receiving financial, advisory, or legal support through investors, growth accelerators, competitions, and other entities or events that can provide additional facilitation in form of office space, network, grant, etc. **RQ1** is descriptive, therefore desk research was applied to obtain the answer.

RQ2 and **RQ3** are narrowed down to the Finnish space industry and directed to the identification of opportunities and challenges occurring when an entrepreneur is willing to start a space company. **RQ3** is aiming to provide solutions and recommendations on how to overcome mentioned obstacles. To answer the questions, the researcher conducted semi-structured interviews with the field's experts who had experience in space start-up establishment in Finland or who continuously worked on development of the industry. The wider justification and description of the research design and data collection methods are presented in the Methodology chapter.

2 Literature Review

The chapter is designed to answer the first research question and gain general understanding of the space industry. At first, it presents evolution of the space industry and provides information on space activities of Finland. Then, it describes existing ways of high technology start-ups funding and facilitation in the world and in Finland. The key words are “space industry”, “private”, “entrepreneurship”, “funding”, and “Finland”.

2.1 Introduction to the Space Industry

Brief History of Space Exploration

To begin with, space attracts attention of humankind for thousands of years. Ancient people were able to employ knowledge about celestial bodies in everyday life, measuring time and having a better terrain orientation (Shuttleworth 2010). Over the centuries, with advancement of science and technology, the contemporary view on the universe started to form. According to Launius (2018), new devices such as telescope and development of physics allowed astronomers of the time to spot and scrutinize space objects a human eye was unable to see. It resulted in introduction of new hypothesizes that lied in the foundation of modern astronomy. (8-35.)

In the beginning of twentieth century, scientists made several discoveries that became essential for further exploration of space. They claimed that the universe constantly expands, formulated the Big Bang theory, and found a way to break Earth’s gravity (Tests of Big Bang: Expansion 2013; Launius 2018, 26). Simultaneously with science development, aviation and arms industries were evolving to meet military and civil demands. The engineering achievements in these fields largely assisted future elaboration of spacecrafts. (Launius 2018, 18-57.)

The results of the Second World War significantly impacted speed of the space industry development. Not only rocketry was boosted, but also two big powers were involved into a confrontation that is known as the Cold War. The conflict between the Soviet Union, the United States, and their allies started after the Yalta Conference in 1945 and continued until the fall of the USSR in 1991. (Edwards, & Edwards Spalding

2016.) The Cold War became a threshold for the other rivalry between the Soviet Union and the United States, also known as the Space Race. The main goals of the countries were to establish dominance in space exploration and push technological advancement. (Holland, & Burns 2018, 3-4.)

Following the chronological timeline, the Space Race started in 1957 with the United States' announcement to put the first scientific satellite into the orbit. The Soviet Union responded immediately by claiming own ambitions. On October 4, 1957, the USSR surprised the world by launching the first artificial satellite called Sputnik-1. It created an illusion of a technological gap between the rivals, making the USA to increase investments into the aerospace industry. (Redd 2017.) A month later, on November 3, the Soviet Union launched Sputnik-2 carrying a dog Laika. Despite of the high ambitiousness of the project, the dog died from overheating and panic during the mission. (Timeline: Space flight 2008.)

The initial American attempt to launch a satellite was not successful, but on January 31, 1958, the United States' Explorer 1 finally reached outer space. It was the first artificial satellite with a scientific mission to study Earth and its environment, not merely circling the orbit. (Redd 2017.) In addition, in 1958, the US organization called National Aeronautics and Space Administration, NASA, was formed (Zak 2018).

In 1959, the USA sent a pair of monkeys into space onboard a Jupiter ballistic missile. Able and Baker became the first living creatures that successfully returned from a space trip. (Timeline: Space flight 2008.) The same happened in 1960 in the USSR with two dogs, Belka and Strelka, that were orbiting Earth for more than twenty-five hours. They became the first animals to return from the orbital flight. (Zak 2018.)

Although the 1960s started with a tragedy when the R-16 rocket exploded at Baikonur Cosmodrome and took more than a hundred of lives, this decade brought several important historical events. On April 12, 1961, the USSR cosmonaut Yuri Gagarin completed the world's first space flight onboard Vostok spacecraft. A month later, on May 5, an American astronaut Alan Shepard made a suborbital flight onboard Mercury spacecraft. (Zak 2018.) In several weeks, the United States' President John Kennedy introduced a space programme aiming to get a human being on the Moon by 1970 (Timeline: Space flight 2008). In addition, the Communications Satellite Act was

signed in 1962 with a goal to make satellite construction more affordable and encourage non-governmental companies to join and build a global communication system. The regulation resulted in establishment of a public Communications Satellite Corporation or COMSAT. (Whalen 1997.)

On July 20, 1969, the Apollo 11 landed on the Moon, making “One Giant Leap For Mankind”. American astronauts Neil Armstrong and Buzz Aldrin became the first men to walk on the Moon. (July 20, 1969: One Giant Leap For Mankind 2017.) After this event, the Space Race between the United States and the Soviet Union slowed down and shifted toward cooperation. According to Weinzierl (2018), this mission made the USA space sector to struggle finding motivation for new accomplishments. The nation became the space race winner, and gradually lost shared interest to space. (175.)

Although the Space Race was a prerogative of the United States and the Soviet Union, there were other actors that considered the space development as a powerful tool for humanity evolution. According to Lania (2016), Canada, for instance, was designing scientific satellites and invented Hermes in 1976 that became the most powerful communication satellite of the time. France launched Diamant missile in 1965, becoming the third nation after the USSR and the USA that autonomously sent own satellite to space. France also was the first European country to establish own space agency. (15-24.)

1960s and 1970s were important for European initiatives due to the first collaboration attempts. Countries like Germany and Belgium understood that they would not be able to independently achieve such success in space as the USSR or the US, therefore they decided to cooperate (Lania 2016, 15-49). As a result, two entities were established: the European Launch Development Organization (ELDO) in 1962, and the European Space Research Organization (ESRO) in 1964. Soon, they were merged and called the European Space Agency. ESA was formed in 1975 by ten Member States: Belgium, Germany, Denmark, France, Italy, the United Kingdom, the Netherlands, Sweden, Switzerland, and Spain. (ESA Turns 30! A Successful Track Record For Europe In Space 2005.)

From scientific and technological perspectives, there were more achievements in 1970s. Conforming to the chronological timeline created by Zak (2018), during the decade, the Soviet Union launched Salyut, the first space station. Russian Venera 7 spacecraft landed on Venus when NASA's Pioneer 10 flew past Jupiter. American Viking touched down Mars' surface, and the first international space flight with the US' astronaut Thomas Stafford and Russian cosmonaut Alexei Leonov was conducted. During 1980s and 1990s, the USSR launched the space station Mir (operating period is 1986-2001) into the Earth orbit, and the Hubble Space Telescope was sent to outer space. Also, the assembly of the International Space Station was begun.

An important event for private space entrepreneurship happened in 1984, when the former US President Ronald Reagan signed the Commercial Space Launch Act (Byellin 2015). The US became the first nation that created regulations for private initiatives to boost space exploration and spacecraft development. According to Reagan (1984), he had an objective to encourage the private sector in commercial aspirations, expecting that his administration would facilitate new ideas and evolvement of transportation and launch capabilities, strengthening American positions in space.

The twentieth century became crucial for evolution of the space industry. Active development of technologies and growing interest in cosmos during the Space Race contributed into science and engineering progress and brought plenty of space-based services and products modern people use regularly: from weather forecast to navigation (Howell 2017). International regulations and national laws for private and public companies were devised, allowing entrepreneurs and scientists to establish own companies and continue advancing rocketry, spacecrafts, and space research.

From the Space Race to New Space

Although active development of the space industry in the twentieth century was driven by competition, it gradually shifted to international cooperation. According to Dordain (2010), in the twenty first century, the industry experienced two significant paradigm shifts, and the change from race to partnership is one of them. Dordain believes that the future of space exploration lies in global collaboration and collective research that is likely to bring robust and stable results. Another paradigm shift is that the efforts of countries were redirected from space to Earth, supporting the new

objective to define benefits of space exploration to humanity. These benefits must impact solutions for existing Earth's problems: for example, boost technological innovation and influence economic growth. Hence, Dordain states that the new century of space exploration is heavily addressing the future of Earth. (9-11.)

However, there is a complementary opinion on the third shift in the space industry: growing importance of private sector. According to Faraco (2017), even though national agencies were partnering with private companies for a while, the first two decades of the twenty first century showed that non-governmental start-ups can bring great advancement to the space industry on their own. For instance, in 2017, SpaceX launched and landed its first reusable orbital class rocket Falcon 9 that became a milestone in spacecraft. In fact, development of such rocket was viewed as highly risky. Nevertheless, since it was successfully tested, Falcon 9 now saves millions of dollars per launch. Moreover, the other privately-held start-up Blue Origin also landed its reusable New Shepherd rocket, making space tourism more accessible.

As more private companies appear, creating innovative technologies and promoting fresh ideas, some experts started considering the exploration period as another race, also known as New Space. According to Datta (2017), the term is used to describe space activities that are commercially oriented and carried out by tens of prospective start-ups. The main features of New Space are rapid invention of innovations, lower expenses, and development of novel applications of spacecrafts and space data.

However, New Space actors are not driven by dominance establishment. They are motivated by customers' needs and new visions which can bring humanity to other planets of the Solar System, get resources from variety of celestial bodies, and enrich knowledge about the Universe. The main goal of the private sector's leaders is to achieve a self-sufficient and large-scale space economy, turning a humankind into a transplanetary species. (Weinzierl 2018, 177-180.)

Furthermore, growing number of space start-ups is beneficial for countries. According to Svitak (2012), governmental agencies started to show their aspiration to collaborate with private companies in order to leverage own costs and drive innovation in the commercial sector. Since the interest to space activities declined as the Space Race ended, some experts believe that private companies of New Space are capable

of significantly pushing the industry's development and promoting importance of science, rocketry, and advanced spacecraft invention (Dashers 2017, 77-88).

Development of the Private Space Sector

Active growth of the private space sector started when the Space Race finished and the role of governmental agencies began to dwindle. Successive establishment of a decentralized set of privately-held start-ups increased competition in the space industry, boosting technological progress and scientific discoveries. (Gustafson 2015, 339.) These companies detected previously unknown niches of the space industry. Conforming to a research of an American bank Morgan Stanley (2017), the worldwide private space sector is currently evolving in eleven sub-industries, more than a half of which emerged during the recent years (see Figure 1) (Sheetz 2017).

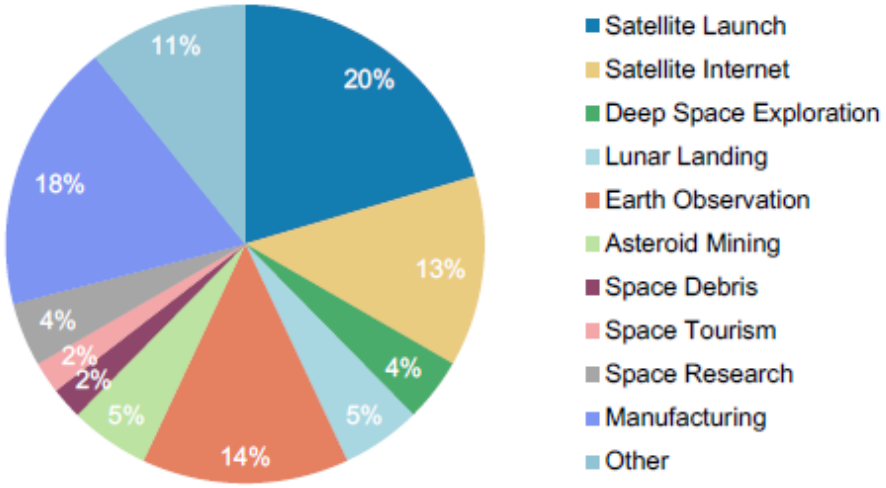

Figure 1 Morgan Stanley Research: Private Space Economy Breakdown (adapted from Sheetz 2017)

Morgan Stanley also added that the industry became more appealing for investors and predicted that it would triple its economy worth until 2040 (ibid.). Indeed, the shift from a centralized and highly-regulated industry to the competitive environment driven by achievements of the private sector caused a wave of interest from investors. Despite of apparent risks and large budgets, investors consider the space industry as profitable and prospective. (Pando 2017.) This opinion is supported by tightening rivalry that fosters invention of new commercial, scientific, civil, and military applications of space data and equipment. Being a dynamic industry, space is an ultimate technological platform and a prosperous area of innovation and capital deployment. (Space, Investment Implications of the Final Frontier 2017, 4-8.)

Nowadays, the private sector of the space industry is considered important for the future of space exploration. Private spacecraft launches significantly outnumber governmental for the last decade (see Figure 2), supporting the idea that the companies of New Space are capable of pushing active development of space technology and space-based economy. According to Dashers (2017), the entities can also invent new applications of space data and equipment to resolve Earth's problems as well as promote space engineering and science, making more people interested in the subjects.

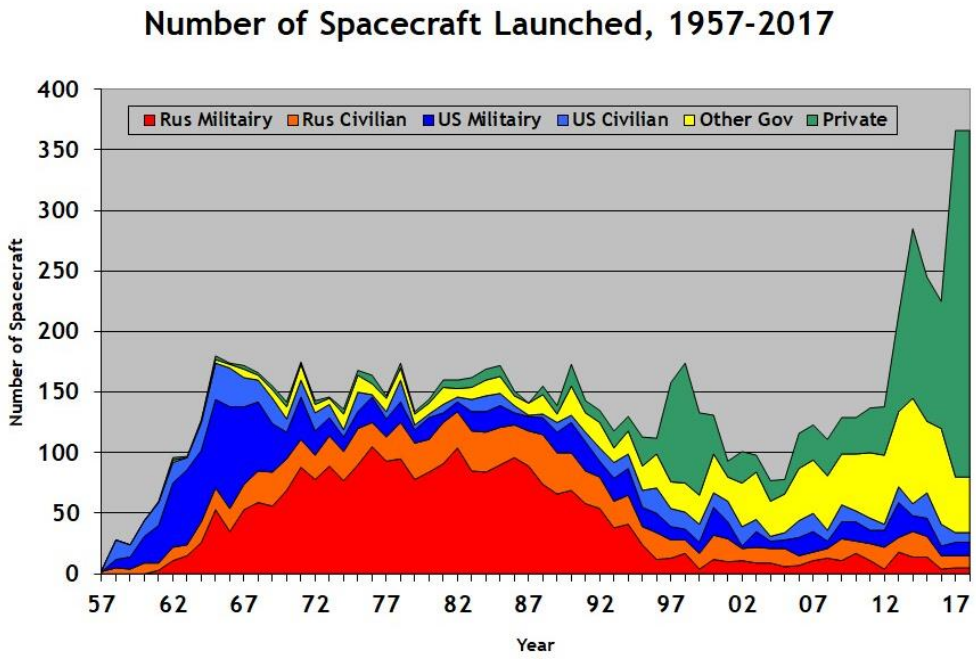

Figure 2 Number of Spacecraft Launch, 1957-2017 (adapted from Lafleur 2017)

2.2 Defining the Present Space Industry

The space industry is represented by space-related public and private actors that are involved into the space economy. The entities construct spacecrafts, its components, launch systems, as well as provide scientific knowledge, services and other products derived from space. The main feature of the space industry is employment of cutting-edge technologies that come along with longer terms for return on investment and project development. Governments are the major customer of space-related activities due to the space value for defence and economic goals. Moreover, although the number of private entities is growing, space remains a state dominated sector due to costly access, technical risks, and need for large markets to ensure viability of space-enabled services. (Schrogl et al. 2011, 49; Space Economy 2014.)

Today, the space industry is commonly divided into four sectors: commercial, civil, intelligence and defence. Civil space is under control of governments and represents state's non-defence activities. Intelligence and defence sectors are known together as national security space and serve to military goals. Commercial sector includes satellite manufacturing, support ground equipment construction, and the launch industry. (Intro to Space Activities 2017.) According to Lania (2016, 9), commercial sector is vital for sustainability of the space industry, because this is the only sector designed to generate revenue.

Value Chain of the Space Industry

Conforming to the ideas represented in Understanding the Space Economy (2008), the supply and demand of space-enabled services and products, new workplaces, and businesses that appeared due to development of the industry, formed a distinct economic system, the space economy. It refers to a value-added chain that begins with research and development of space equipment and finishes with provision of space-enabled services to the end users. (4-9.) The economy is classified into two segments: "upstream" or designing and manufacturing spacecrafts, and "downstream" or application of space data to Earth-related objectives (Lania 2016, 11).

According to the OECD's work "The Space Economy at a Glance 2014" (2014), a value chain is a set of activities implemented by an organization in order to advance a good or service from a concept phase to final use. These activities imply logistics, marketing, design, and other tasks which must add unique value to product that goes to the market. The space sector consists of projects of different sizes and importance, thus, its value and supply chains are complex and are likely to include corporations from different countries. (22.)

To date, one of the most comprehensive compositions of the space industry value chain was proposed by Lania (2016, 10). The model serves as a backbone for the current situation and is beneficial for future elaboration of more detailed frameworks. Lania (2016, 11) claims that the value chain consists of four large components that have specific features and move from hardware and direct space activities to data applications consumed by final users (see Figure 3).

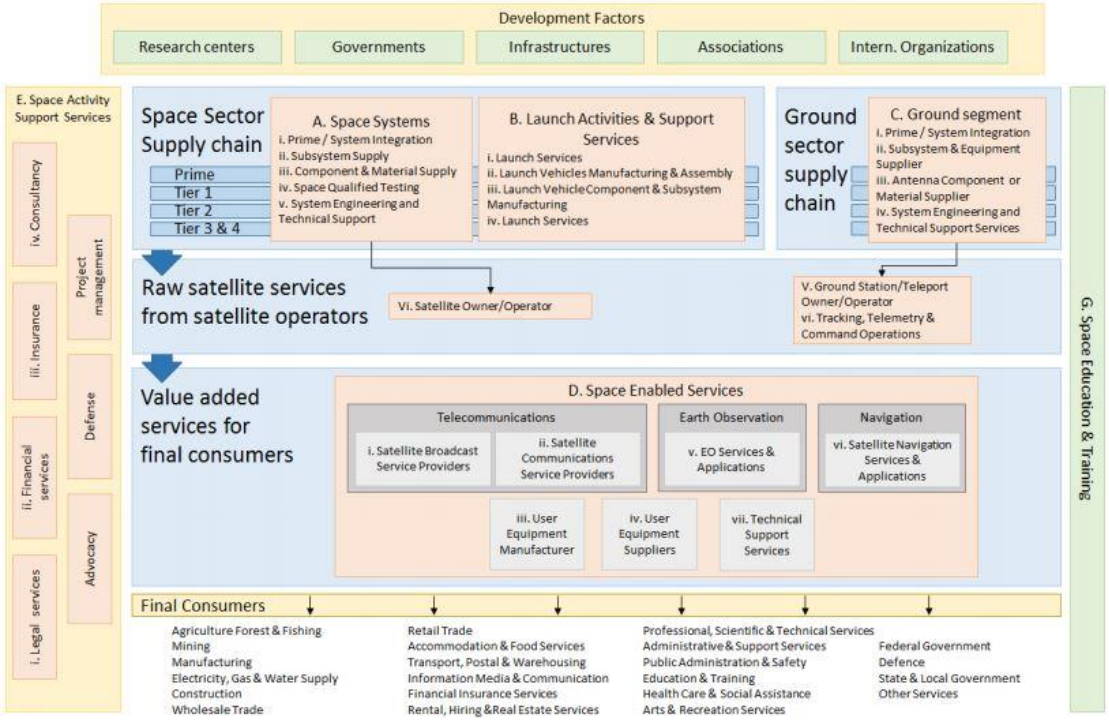

Figure 3 Composition of the space industry (adapted from Lania 2016, 10)

The first component is “development factors”. It refers to several actors that are essential for endorsing research and financing projects that generate non-commercial profit or uncertain in the results. These actors usually are public, non-profit organizations such as space agencies and governments. (ibid., 11.)

The second component is “space manufacturing supply chain”. Following the ideas of Lania (2016), this is an upstream segment of the space economy, the main elements of which are “primes”, “tier 1”, “tier 2”, and “tier 3 and 4”. The main role of primes is designing and manufacturing complete spacecraft systems, such as launchers, for commercial or governmental utilization. These activities require extensive financial, engineering and technological capabilities, as well as sufficient investments to R&D. Hence, huge companies such as Boeing and Airbus lead the segment. (11.)

“Tier 1 and 2” organizations design and assemble major spacecraft sub-systems and equipment. These activities also require high-technological and financial resources, therefore the line between tier 1 and 2 companies and primes is often indistinct. Typically, tier 1 and 2 serve as suppliers for primes. (ibid.)

“Tier 3 and 4” are small or big electronics corporations with competences in development of specific electromechanical, electronic, and electrical materials and details

and with limited activities in the space industry. They also supply the components to higher tiers, helping the primes to deliver the final product to markets. (ibid.)

The main industries of the “space manufacturing supply chain” are Space System and Launch Activity. Space system consists of firms related to satellite design, assembly and launch, whereas launch activity refers to companies that manufacture space-crafts capable to reach outer space. (ibid., 12.) Although both industries require large funding and are vulnerable to risk, more private investors are ready to finance such upstream initiatives due to probable high revenues and success of some start-ups.

Additionally, in parallel with the “space manufacturing supply chain” goes the “ground sector supply chain”. This segment consists of prime and tier suppliers that design and create products and services for better functioning of satellites. For in-stance, these companies produce earth-based structures that are necessary for the satellites’ control, launch, and signals reception. (ibid., 12.)

The third component of the space industry value chain is “raw satellite services and value-added services”. In other words, these are the downstream activities that im-ply application of data from satellites to Earth-related missions. The value chain’s component represents provision of raw satellite signals by companies that own and operate satellites and ground stations. The data is being sold to various customers, from governmental agencies to commercial corporations. (ibid., 12.)

The lowest stage of the value chain is the “value-added services”. It includes all enti-ties that use satellite data to provide own services. Usually, the firms are not part of the space community, and may be privately-held, publicly-funded, or run individually. Nonetheless, the value-added services is the most profitable segment of the space economy in terms of revenue, as well as the main initiator of economic-driven inno-vations in the space industry. (ibid., 12-13.)

The “space-enabled services” show the activities involved in the “value-added ser-vices”. Satellite signals are used for various products: from telecommunications and navigation to Earth observation and natural disaster management. Many households and industries, such as mining, defence, and agriculture, heavily rely on such space services in their everyday work. (ibid., 13.)

The last component of the value chain is positioned aside of the core activities and represents a range of services (consultancy, insurance, space education, etc.) that are essential for the industry well-being. The space sector strongly depends on R&D, constant funding of which ensures conduction of researches that can be employed at higher stages of the value chain. Hence, for further development of the space economy, regular and extensive investments, legal, managerial assistance provided by companies with different competences and specializations are required. (ibid., 13.)

2.3 Introduction to the Finnish Space Industry

Overview of the Finnish Space Industry

According to Seppinen (2003), Finland entered the Space Era after joining the Committee on Space Research, COSPAR, in 1964. During the next decades, Finnish scientists were working on applications of data from Earth observation satellites, and development of geophysical science, such as geomagnetism and auroral studies. (5-7.) The first significant space project took place in 80s, when Sweden, Russia, and Finland cooperatively devised and launched a plasm analysator Aspera to Mars. These years were auspicious for Finnish space science as national competences expanded to component production and satellite positioning. (History n.d.)

In 1987, Finland had a status of Associate Member of the European Space Agency but only in 1995 the country received a full ESA membership. It allowed Finland to improve level of space research, strengthen international cooperation, and let local universities and research organizations participate in transborder projects. (History n.d.) However, only in 2017, the country became a space nation as the first Finnish nanosatellite built by Aalto University was launched into cosmos. This gave rise to the national New Space sector and was followed by launch of the first Finnish commercial satellite by start-up ICEYE in January 2018 (Adamowski 2018).

Nowadays, Finland is globally known for expertise in space and atmospheric research, as well as for high-quality software and electronics for various spacecrafts. The national space activities consist of four areas: scientific research of space and Earth, observation of Earth, satellite positioning, and spacecraft components manufacturing. (Space offers new opportunities 2018.) In other words, the Finnish space

industry primarily focuses on civil activities and employment of space technologies and data to benefit individuals and specific business sectors.

The Finnish space industry has around 70 companies that operate in the space-related fields, and more fresh start-ups are expected to enter the area being facilitated by the state's programs (Finnish Companies in Space Industry n.d.). Since Finland is lacking own space agency, space activities are conducted through the ESA projects, national programs, and international agreements (European Space Agency n.d.). The Ministry of Economic Affairs and Employment of Finland is responsible for Finnish space policy, authorization of space activities and maintenance of the registry of space objects (National space legislation 2018).

To create opportunities for local companies and expand own role in the space industry, Finland partners with other countries and organizations. Being an ESA member allows Finnish specialists to participate in large projects which cannot be managed by a single European state. Cooperation with the European Southern Observatory (ESO) and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) provides Finland with possibilities to contribute into deep space exploration and satellites data gathering programs elaboration. The other important partners and contributors of Finland are Canadian Space Agency (CSA), European cooperation in the Finnish Meteorological Institute, as well as local associations such as the Finnish Space Research Society, Remote Sensing Club of Finland, and Ursa Astronomical Association. These collaborations promote knowledge sharing and facilitate technological innovations and progress of space exploration. (Yhteistyöverkosto n.d.)

Governmental Programs and Regulations

The first Finnish space legislation, Act on Space Activities, was signed on 12 January 2018 by Finland's President Sauli Niinistö (Adamowski 2018). The main objectives of the act are to create a clear framework for national space industry, and to provide a predictable and legally explicit operating environment. It is designed to promote competitiveness and attract new entrepreneurs and investors to Finland. The Space Act regulates space activities of Finland by authorizing operations related to usage and procurement of such space objects as satellites, launch vehicles, and probes. (National space legislation 2018.)

The national space strategy is supported by the public growth accelerator Business Finland. Conforming to ideas presented in the New Space Economy (2018), the program searches for innovative space-related start-ups to provide them with sufficient funding and extensive networks. Additionally, the program funds Finnish manufacturing companies, data utilization firms, and scientific researches. The main objectives are to reach an annual revenue of €600 million by 2020 in the services provided by the space sector, double the exports of the involved organizations, and make the Finnish space ecosystem a key player in New Space by 2025.

Establishment of the ESA Business Incubation Centre in Finland also supports the objectives of the national space program. As it is stated in the ESA Business Incubation Centre to be opened in Finland (2017), approximately 50 local technology start-ups will be provided with growth boost alongside with financial and technical facilitation during the next five years. ESA BIC Finland, in turn, searches for ambitious entrepreneurs who can offer new technologies to ESA and its partners as well as who can apply existing technologies and space data to terrestrial needs (About Us 2017).

All publicly-funded space activities in Finland should align with the Finland's space strategy for years 2013 to 2020. The strategy was elaborated in 2014 by the Finnish Space Committee that is operating under the Ministry of Economic Affairs and Employment. The policy aims to achieve the world's best results in the following areas by 2020: devise space-based applications to meet demands of the Arctic region, reinforce services competitiveness by introducing open source geographical data, raise the scientific research level by participating in ESA and EU programmes, and improve specialization and applications of spacecraft equipment to respond tightening competition. The Finnish Space Committee set the objectives and created development strategy, and it is the body's responsibility to regularly monitor the policy's implementation. (Finnish Space Committee 2014, 3.)

The Main Actors in the Finnish Space Industry

The main areas of the Finnish space know-how are production of spacecraft software and electronics, development of lightweight carbon fiber structures and microwave technologies, astrophysics, planetary observations, and applications of satellite data for a better management of natural resources (Finland in Space 2018). The majority

of the Finnish space companies either manufacture components and electronic solutions for spacecrafts or provide end users and industries with space-enabled services such as high-quality topographic maps and well-elaborated geographic information systems. Space and atmospheric research are the other fundamental areas of the Finnish space industry, therefore, Finland has space science research organizations and Earth observation science organizations. Mainly, these entities are local foremost universities and institutes, such as Finnish Meteorological Institute and Aalto University, but the list also includes Finnish Centre for Astronomy with ESO and VTT Technical Research Centre of Finland. (Space Research n.d.)

Although Finland cannot boast of famous names as Jeff Bezos and Elon Musk, the country has some pioneers who significantly contributed into the space technology advancement and science popularization. According to Amos (2018), a young Finnish start-up ICEYE launched its first synthetic-aperture radar satellite into Earth's orbit in January 2018. The main breakthrough of the launch was the low weight of the satellite. Typically, such powerful spacecrafts capable of making precise pictures of Earth without being disturbed by darkness or changing weather must be big in size and mass, measured in tones and meters. Whereas ICEYE's satellite weights less than 100kg and fits the box of size 80cm by 60cm by 50cm. This innovation made investors to believe that the start-up is going to expand the global satellite market.

The other example of a known Finnish company is Space Nation. This start-up was financed by crowdfunding, where it received $3.4 million for elaboration of a reality show and a mobile app that provided users with activities and knowledge from actual astronaut training program (Space Start-ups Growing in Finland 2017). Created in partnership with NASA, this application not only educated users but also encouraged challenging environment where people competed online for a spot at bootcamps and, ultimately, at a space ship (Space Nation Navigator n.d.). However, these ideas were not destined to be performed. Despite of successful start and reception of sufficient investment, the start-up had to declare its bankruptcy on November 16, 2018 (Virtanen 2018).

Nevertheless, the private sector of the Finnish space industry merely started its active development. According to Reaktor Space Lab takes off (2018), the other young

start-up launched the Finnish commercially-built nanosatellite into space on November 29, 2018. After successful implementation of the Hello World mission, the Reaktor Space Lab plans to expand its business and facilitate Finland in becoming the leading country in space engineering.

In fact, there are more Finnish companies that actively participate in spacecraft advancement and space exploration. RSI Solutions is a professional manufacturer of software and electronics, and its products currently orbit Earth, explore Mars and Venus. Arbonaut works on GIS solution for forest inventory and natural resource management. DA-Group devises digital systems, radar, and RF subsystems, and is a subcontractor of several satellite large-scale integrators (LSI) and of ESA. (Finnish Companies in the Space Industry 2018.) These companies form a small part of the Finnish space industry that is expected to grow in the next years, facilitated by the state's programs and private investors.

2.4 Funding Methods for Private High-Technology Start-ups

Start-ups and High-Tech Industries

According to Ries (2010), start-up can be defined as "human institution designed to deliver a new product or service under conditions of extreme uncertainty". The other definition of start-up is "organization formed to search for a repeatable and scalable business model" (Blank 2010). The main features that distinguish start-ups from other new entities are scalability, focus on growth, geographical independence, new business models and technologies (Robehmed 2013).

The high-technology sector is composed of all industries that have a significant part of workforce dedicated to science, technology, engineering, and mathematics fields; ensure high proportion of research and development employment; manufacture technologically-advanced products; and utilize innovative methods, high-tech goods and services in production processes. In 2005, Bureau of Labor Statistics identified 14 high-technology industries (see Figure 4), where industries such as electronic component production and aerospace product and parts manufacturing partake in and compile the space economy. (Hathaway 2013, 18-19.)

Costs of a high-tech start-up establishment and market barriers vary from industry to industry, but substantial risks of failure are common for all the actors (Sorvik 2015). Moreover, since some countries lack amounts of risky money, the majority of ventures collapse during the early stages, unable to receive sufficient investment. The thesis' subchapter is aiming to present the main funding methods available for private entrepreneurs in the high-technology sector.

NAICS Code	Industry
Information and Communications Technology (ICT) High-Tech	
3341	Computer and peripheral equipment manufacturing
3342	Communications equipment manufacturing
3344	Semiconductor and other electronic component manufacturing
3345	Navigational, measuring, electromedical, and control instruments manufacturing
5112	Software publishers
5161	Internet publishing and broadcasting
5179	Other telecommunications
5181	Internet service providers and Web search portals
5182	Data processing, hosting, and related services
5415	Computer systems design and related services
Miscellaneous High-Tech	
3254	Pharmaceutical and medicine manufacturing
3364	Aerospace product and parts manufacturing
5413	Architectural, engineering, and related services
5417	Scientific research-and-development services

Figure 4 High-technology Industries (adapted from Hathaway 2013, 19)

Funding Methods

Bootstrapping. According to Paul, Whittam, and Wyper (2007, 8-21), start-ups founders tend to use internal financing sources before addressing third parties. Such self-financing way is called bootstrapping, and it suites to companies that do not require large investments. This approach matches with the lean start-up concept as well, because bootstrapping facilitates the idea to employ existing resources before getting investment from external sources. The main benefit of the method is lack of additional co-founders, consequently, operations are under control of initial entrepreneurs. On the other hand, it also means less assistance from more experienced partners and business networks. (Čalopa, Horvat, & Lalić 2013, 25-26.)

Some entrepreneurs tend to generate initial funds with help of friends and families. This type of informal funding together with crowdfunding and bootstrapping refer to

seed investment or initial money necessary for a company establishment. To the high-technology start-ups, the other peculiar way of getting seed financing is private investors who uncover business potential of an idea and assist its development. (Čalopa et al. 2013, 27.)

Bank Loans. Getting a bank loan is one of the fundamental sources of funding. Simultaneously, this is one of the hardest ways to receive investments due to complex, lingering procedures, and rigorous bank's requirements. According to Čalopa and colleagues (2013, 26), since many entrepreneurs are young and do not have property or sufficient credit history, it is almost impossible to meet the obligations and receive a loan. Moreover, high-technology start-ups have more difficulties getting credits due to high vulnerabilities and risks, and therefore are unlikely to use bank services (Brown, Degryse, Höwer, & Penas 2012).

Government Programs and Grants. Understanding the importance of high-technology sector for the economic growth and image of the country, some states attempt to support establishment of high-tech start-ups. For instance, in the United Kingdom such assistance is not only advisory, in form of consultancy on taxation and legal issues, but also financial, as a loan with a fixed interest rate or a start-up competition that guarantees funding to winners. Additionally, the government annually invests into research and development of new technology, focusing on Artificial Intelligence, robotics, and biotechnology. (Carey 2017.)

The other example of a governmental support is the US Small Business Innovation Research (SBIR) program. According to Beesley (2017), SBIR is the world's largest source of early stage capital, therefore it is also known as the America's Seed Fund. The main purpose of the organization is to facilitate prospective high-tech start-ups with grants and contracts to cover R&D and product commercialization costs. The SBIR awards entrepreneurs in three phases: firstly, companies receive around $150,000 to understand if the business idea has commercial potential; during the second phase, they receive around $1 million for two years to expand R&D and estimate the product's commercial viability; and during the last phase, start-ups transfer from the lab to the market and start searching for non-government investors. Con-

forming to ideas of Ungerleider (2018), governmental grants, funding, and other incentives remain the main supporting source for the high-tech world, especially, for the space industry.

Angel Investors. Paul and colleagues (2007, 8-21) found that in case external investments are necessary, entrepreneurs usually choose equity as a source over the debts to banks. Here come Angel Investors who, as a rule, provide up to $500,000 of financing in exchange for ownership equity or convertible debt. These are the accredited investors who use own money and can facilitate entrepreneurs with additional business advices and contacts when required. Being private individuals, angel investors search for start-ups with noticeable potential, and invest into their growth at the earliest possible stages, before many venture capital funds are able to. (What is Angel Investment? 2016.)

Venture Capital. Venture Capital Investments refer to financial support of start-ups by venture capitalists: individuals, firms, or funds ready to invest into a company in exchange for an appropriate ownership part. Venture Investors usually are private entities who search for risky projects that have potential to bring high return on investments. (Čalopa et al. 2013, 29.) According to Deeb (2016), there are several types of VC investors: “seed stage” prefer financing just established start-ups to boost their growth, "early stage" concentrate on companies that already proved viability of their concepts, and “growth stage” invest into entities that are expanding their market share. Venture Capital is a risky investment type that is uncertain in results since the majority of start-ups fail, but it may bring great returns when the firm is correctly-chosen. Hence, VC tend to select established start-ups to lower risks.

Business Incubator. Business incubators provide entrepreneurs with necessary help on different stages of a start-up establishment and running. As a rule, such organizations facilitate entrepreneurs with office spaces, legal expertise, networks, and other important skills, knowledge, and equipment necessary for successful development of a concept. Business incubators can either grant companies with own minimal funding or help entrepreneurs to elaborate a pitch deck and present it to possible investors. (Nawal 2018.) Business incubators have a purpose to assist start-ups in their growth, primarily focusing on co-working environment and shared office resources (Cohen & Hochberg 2014, 5).

However, the reasons and facilitation differ. According to Nawal (2018), there are three types of business incubators. The first is academic incubator that represents services provided by a university to students. By supporting and embodying the ideas, an institution attracts more applicants, reinforcing own image. The second is free starting incubator, that provides free initial services. The third is private incubator, and it may charge for services or support start-ups in exchange for equity.

Business Accelerator. Similar to incubators, the main purpose of business accelerators is to facilitate start-ups and boost their market interaction during the early stages of development. However, there are some differences between these programs (see Figure 5).

	Accelerators	Incubators	Angel Investors
Duration	3 months	1-5 yrs	Ongoing
Cohorts	Yes	No	No
Business model	Investment; non-profit	Rent; non-profit	Investment
Selection frequency	Competitive, cyclical	Non competitive	Competitive, ongoing
Venture stage	Early	Early, or late	Early
Education offered	Seminars	Ad hoc, hr/legal	None
Venture location	Usually on-site	On-site	Off-site
Mentorship	Intense, by self and others	Minimal, tactical	As needed, by investor

Figure 5 Summary of the Differences between Incubators, Investors, and Accelerators (adapted from Cohen et al. 2014, 9)

To begin with, the duration of accelerator programs is limited to several months whereas some firms participating in incubators may graduate in a couple of years after start. Such restricted timeframe speeds the company's lifecycle, making it either grow or fail quickly. Secondly, unlike incubators, business accelerators encourage emotional bonds between founders by accepting specific number of entrepreneurs, making them begin and conclude the program in a cohort. Thirdly, these programs have different educational approaches: while incubators' services as accountants and lawyers tend to be fee-based, accelerators provide extensive teaching seminars explaining variety of entrepreneurial topics that might be beneficial to the cohorts. Finally, mentorship is an integral part of accelerators' programs and it allows batches to extend professional network, whereas in incubators, mentorship is not so common. (Cohen et al. 2014, 9-12.)

Start-up Competitions. Participating in various start-up competitions is the other opportunity for companies to find funding, attention, and validation. According to Pozin (2015), this method represents pitching and presenting a concept or a minimum viable product to investors, other entrepreneurs, and founders. The winners can get prizes as capital without an obligation to payback or sacrifice equity. The most known competitions are TechCrunch Disrupt where entrepreneurs pitch to win $50,000 and LeWeb that is one of the largest tech conferences with the most influential audience in the high-tech sector.

2.5 Funding Start-ups in the Space Industry

Specificity of the Space Industry Start-ups

In fact, technical and commercial risks are different for the space industry actors. Considering the ventures operating in the downstream segment of space that work with the space data application, these entities have potential to cover bigger markets since they provide services to final users: whether to companies, to specific industries, or to regular human beings. Establishment of such start-ups does not usually require huge investments or long research processes, and therefore, the risks and uncertainties are lower. However, in the upstream segment, money amounts and market and technology uncertainty grow while number of customers decreases, leaving space for government and for other corporations. The value chain expands, implying cooperation with international organizations. Moreover, research process may take substantial time before development of a real product, as well as elaboration or launch of spacecrafts are under control of national legislations, meaning that entrepreneurs have to fulfil additional requirements in order to establish a start-up and embody their concepts. (Space Economy 2014; Lania 2016, 9-14.)

Since the space industry is an integral part of the high technology sector, the funding methods presented in the previous sub-chapter are commonly used by space entrepreneurs. For example, Jeff Bezos and Elon Musk initially financed their start-ups from own funds, applying bootstrapping approach (Fernholz 2017). However, the majority of founders do not have sufficient investments to launch upstream companies such as SpaceX, hence, they search for other seed financing sources.

In the global business environment, there are plenty of investors, competitions, and programs that encourage development of space technology start-ups. In this sub-chapter, the most popular incubators, grands, and investor networks are described at the worldwide and European levels.

Worldwide Stage

According to Jacobson (2017), the space industry becomes more attractive not only for private investors, but also for accelerator and incubator programs which number is annually growing. Though the programs are different, they share a goal to help entrepreneurs to successfully launch and run ventures, as well as promote an idea of decentralized control over space activities. Usually, such programs are national and require local citizenship or firm registration in the country where the program is held.

Nonetheless, there are some worldwide programs and competitions for space start-ups endorsement, that aspire to develop the entire industry instead of national. For instance, the Starburst Accelerator is one of the global and well-known accelerator programs that focuses on the aerospace industry and provides entrepreneurs with a chance to offer their ideas to the leading aerospace and aviation companies of the world. The program gives to participants opportunities to contact the most influential experts, receive necessary mentoring, and travel around Starburst's offices that are located in seven countries, from the USA to Singapore. (Accelerator n.d.)

The other example of international program that encourages people to contribute into development of the space industry and helps them to extend business network is ActInSpace. It represents an international competition supported by ESA Space Solutions, ESA BIC Sud France, and CNES, and it incorporated more than 2000 participants from 32 countries in 2018. (About ActInSpace n.d.) However, such type of competition might not be considered as typical financing source, but it can be beneficial for team-building, understanding of the current challenges in the space industry, network expansion, and first connection with investors.

To receive seed funding, space start-ups must not only address space-related programs. They can also participate in global competitions and business incubators or accelerators that support development of ventures from different industries during the early stages and do not have a pre-defined theme. According to Jacobson (2017),

the popular international accelerators like the Founder Institute and TechStars have extensive programs for entrepreneurs, and space ventures founders can also benefit from participating, finding probable stakeholders, receiving reasonable assistance, and working on concepts' commercialization.

European Level

The space industry is an important sector for the European Union because it facilitates sustainable economic growth, scientific progress, and workplaces creation. The sector ensures independency of the EU and assists in solving current issues regarding social and global challenges. (The Space Industry n.d.) Therefore, to encourage and support entrepreneurship in the European space industry as well as attract new actors and private investors, the EU authorities together with ESA elaborate and hold variety of space-dedicated programs, competitions, and events.

Nowadays, Horizon 2020 is the biggest research and innovation program in the EU. The aims of this program are facilitation of the world-class science production and removal of barriers to innovations. The program started in 2014 having approximately €80 billion to invest into companies besides private funding, and is ending in 2020. (What is Horizon 2020? n.d.) After several years of operation, the program financed a line of projects. According to the official website of the Finnish start-up ICEYE (2018), the firm also received funding from the European Union's Horizon 2020.

ESA Business Incubator Centres is the other initiative that is originated by European Space Agency. The program aims to support private entrepreneurship in the space industry of Europe. Conforming to the description of ESA BIC in the official website (n.d.), there are twenty sites located in European countries, from Norway to Portugal. Operating for more than fifteen years, the ESA BICs supported around 650 start-ups by providing them with office space, management and logistics assistance, technical facilities, financial opportunities, and partners search.

Nonetheless, there are far more funding sources, both private and public, available for start-ups registered in the European Union. For instance, European Business Angels Network launched EBAN Space accelerator program that aims to improve Europe's space ecosystem in terms of innovation, funding, and entrepreneurship (Mission n.d.). Besides variety of accelerator and incubator programs, there are several

European competitions and VC firms, such as Practica Capital, that focus on technology-oriented start-ups to provide financial support during different stages.

2.6 Funding Space Start-ups in Finland

When entrepreneurs decide to establish a space-related start-up in Finland, they can appeal to several companies and programs that are designed to provide necessary help. The major public player that offers funding to companies is Business Finland (Suomi Avaruudessa n.d.). Conforming to New Space Economy (2018), under the program, Business Finland searches for start-ups with a potential to reform the space sector, and grants them with financial support, assists in promotion and expansion of market knowledge, and gives access to wider network and cooperation with global research centres and universities. Business Finland also supports space research, prospective manufacturing companies, and ventures concentrating on data utilization.

The other important space program that is supported by government is ESA Business Incubation Centre Finland. The centre was founded in 2017 with an aim to discover novel space-related start-ups and provide entrepreneurs with resources such as information and funding (About Us 2017). ESA BIC Finland searches for companies that create concepts and business models for New Space solutions and technologies, from robotics and Artificial Intelligence to satellites positioning and navigation (Tuominen 2018). According to Lintilä (2018), New Space Economy and ESA BIC Finland are the examples of how national authorities, businesses, and research actors began to facilitate commercial opportunities and growth of the space industry (Public administration to support space business opportunities in Finland 2018).

Besides the programs, there are several angel network firms, venture capital companies, and institutes that aspire to assist start-ups in their growth. For instance, the Finnish Business Angels Network, FiBAN, is a large national non-profit organization that helps private investors and entrepreneurs to make a match (Etula 2017). Venture Capital firms, such as VTT Ventures, provide technology firms and scientific projects with seed financing as well as help to mature their ideas (About VTT Ventures n.d.). Moreover, some local universities have own business generators and advisors. For example, Aalto University's Start-up Centre supports ventures during the earliest

phases of development (Business Generator n.d.). Additionally, Finland regularly holds the world's leading start-up event Slush, where founders can contact investors directly as well as participate in the Slush 100 Pitching Competition to win special prizes and attention of the audience (Pitch Your Top Ideas At Slush 100 2018).

3 Methodology

3.1 Research Purpose

Typically, academic researches are conducted with a specific aim: whether to study an unknown phenomenon, to create an accurate image of an existing event, or to identify and explain connections between variables. In other words, depending on the reasons behind the study initiation, the research may have descriptive, exploratory, or explanatory purpose. In special cases, investigators adopt more than one purpose, for instance, to pursue descripto-explanatory research, as well as they may change the initial aim as the investigation progresses. (Saunders, Lewis, and Thornhill 2009, 138-140.)

Exploratory Research

Exploratory research is used when a situation or problem is not studied deeply. It requires preliminary data collection on the research topic, and is aiming to develop a hypothesis, rather than test existing theories. (Sachdeva 2008, 14-15; Kothari 2004, 4.) According to Saunders and colleagues (2009, 140), there are three conventional ways to pursue exploratory study: by reviewing the literature, by using focus group interviews, and by questioning the area's experts. Hence, exploratory research mainly implies gathering and analysis of qualitative information.

The main feature that differs exploratory investigation is lack of rigid structure in the research design. Flexibility, purposive sampling, and unstructured tools for data collection allow researchers to consider phenomenon from different angles and get relevant insights into the problem. (Kothari 2004, 35-39.) Nonetheless, though flexibility is usually considered as an edge, the lack of solid framework may lead to biased, subjective, and non-representative results (Sachdeva 2008, 15). Therefore, it is crucial

for investigators to create and continuously follow methodology and research design that can ensure the overall quality of study outcomes.

This research has an exploratory purpose. Since the topic of private entrepreneurship in the Finnish space industry recently became actual, there are no studies on the common challenges and opportunities entrepreneurs face while financing and establishing their space ventures in Finland. Thus, to reach the research objective and answer the research questions, it was necessary to explore the field in-depth, utilizing such principles of exploratory research as interviewing the experts and studying relevant literature. These techniques of data collection became the main instruments in identification of funding methods in the high technology sector and the space industry, assisted in comprehension of the current situation in the Finnish space industry, as well as in revealing the patterns of private space start-up establishment in Finland.

3.2 Research Approach, Methodological Choices and Design

According to Ditsa (2004, 763), Kerlinger (1986) described research design as a structure and strategy created to obtain answers on research questions. In other words, research design refers to a general plan for an investigation conduction and acts as a framework for a researcher, defining every stage of the research process: what sort of data must be collected, from which sources, and how it should be analysed (Saunders et al. 2009, 136-137). An elaborated research design ensures that the results are found as unbiased and accurately as possible, assisting a researcher in proving validity, objectivity, and reliability of findings (Ditsa 2004, 763).

These features highlight the importance of an appropriate research design for investigators, guaranteeing coherent and transparent processes of data collection and analysis in case of accurate design formulation and successive following.

To formulate a research design, the investigator decided to follow the concept of the research “onion” introduced by Saunders and colleagues (2009, 108). The main driver of the decision was the entirety of the model. It clearly defines the research stages and their sequence, helping to create a coherent plan of actions. The onion contains six layers, starting with the outer layer that represents research philosophy, and moving to the core, to data collection and analysis (see Figure 6). In practice, the

model implies selection of research approaches, strategies, and information acquisition techniques in a manner that all the layers are consistent and not in a contradiction with each other.

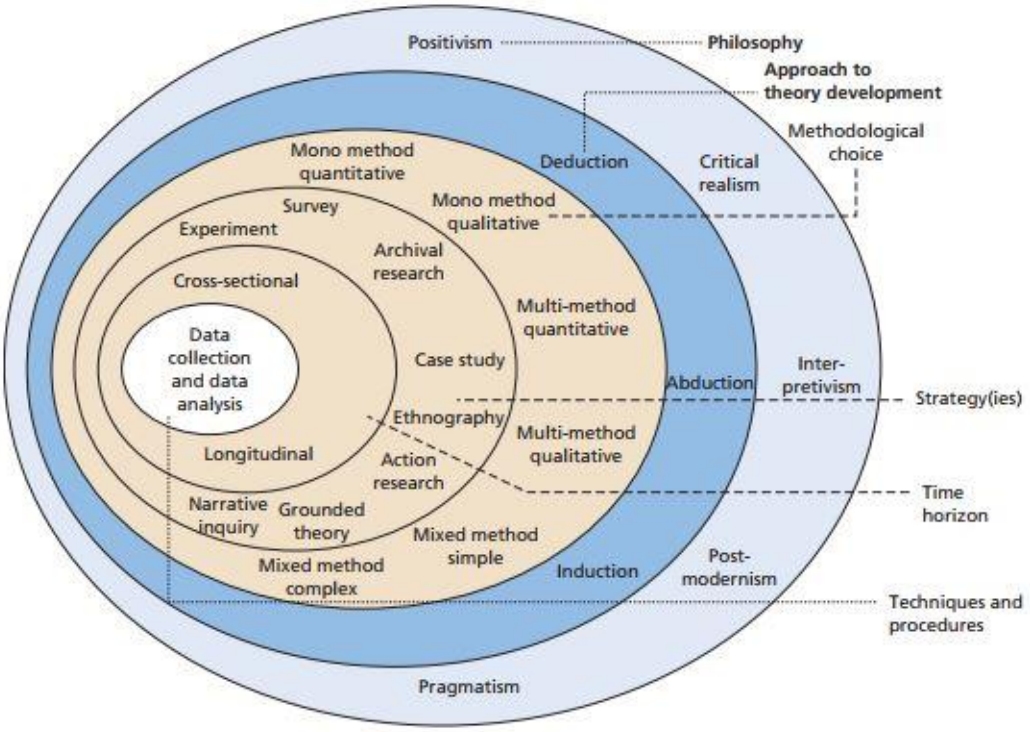

Figure 6 The research 'onion' (adapted from Saunders, Lewis, & Thornhill 2015, 124)

Research Philosophy

The first layer of the research onion is research philosophy. The philosophies guide further structure of research design, propose a specific way of information collection and analysis, as well as set limitations to the following selection of methodological choice and strategies. By determining the main direction of an investigation, a selected research philosophy comprises beliefs and assumptions about the investigators' view of the world, especially, how they see relationship between knowledge and process of its development. Thus, adoption of a research philosophy requires reflexivity and thorough thinking. (Saunders et al. 2009, 106-120.)

The philosophy of **interpretivism** was adopted for this research. According to Saunders and colleagues (2015, 140-141), the aim of interpretivism is to construct new comprehension of social world by working with subjective meanings rather than creating generalizations. In fact, interpretivism is subjectivist due to complexity and multiple interpretations. This philosophy is applicable to investigations that aspire to

study social phenomenon in its natural environment: a researcher enters the world, reflects on it, and interprets own conclusions (Sahay 2016, 3). The crucial factor of interpretivism philosophy is the necessity to be empathetic, so an investigator, entering the social world, could understand the way how a research subject observes it. Hence, studies under the interpretivist philosophy are value bound and qualitative, and most often require in-depth investigations within a sample of a small size. (Saunders et al. 2009, 115-119.)

Indeed, the objective of this research is to learn about business opportunities and challenges private entrepreneurs encounter during their space start-ups establishment in Finland. In order to detect such aspects, it is necessary to observe the Finnish space community as well as the national space industry from perspective of its members. In this social world, the members are the Finnish government, other public actors, and space entrepreneurs. Thus, acting under the interpretivist philosophy, the researcher is allowed to make a purposive choice of the industry's representatives and conduct semi-structured interviews in order to comprehend the reality from their angles, spot the common patterns in their visions, and build new understanding of the field.

Research Approach

The second layer of the research onion refers to selection of a research approach. The approach can be deductive, inductive, or abductive. Deductive approach is used when a researcher starts with a theory and designs a study to test it. Usually, deduction is associated with positivism philosophy and quantitative research. On a contrary, inductive approach implies collection and analysis of qualitative data, and is mostly related to interpretivism philosophy. A researcher begins with information acquisition, aiming to explore a phenomenon and build a theory. Abduction, in turn, represents a combination of deduction and induction. It means that an investigator begins with a phenomenon exploration to create a theory. Then, tests the theory through additional wave of data collection. (Saunders et al. 2009, 124-127; Saunders et al. 2015, 144-145.)

For this research, **inductive approach** was utilized. Since there is not enough initial information about the research subject, it was impossible to start with a theory. The

investigator began with data collection in order to study the notion of the space industry, to understand characteristics of the Finnish space sector, to acquire information about funding methods, and to learn experiences and opinions of the industry's members. After this stage, a researcher had sufficient amount of information to move to a conceptual framework development: she identified the common themes and patterns of a space start-up establishment in Finland and found relationships between them.

According to Saunders and colleagues (2009, 127), the main features of induction are flexibility of structure that accepts changes as research progresses; attention and comprehension of investigation context and meanings people attach to events; collection and analysis of qualitative data and use of small sample of subjects; usage of less formal techniques; and reduced need for generalizations.

Methodological Choice

The next layer of the research onion is the methodological choice. It refers to the investigator's selection between mono method of data collection and analysis and multiple-methods (see Figure 7). According to Saunders and colleagues (2009), a researcher, depending on previous decisions, chooses either to utilize a single technique of data gathering and analysis or address more. Mono method implies collection and analysis of either qualitative or quantitative data through one technique, whereas multi-method allows applications of several techniques and analysis procedures. Alternatively, mixed-methods consider usage of both, qualitative and quantitative information, either combining techniques of data collection and analysis or not. (151-153.)

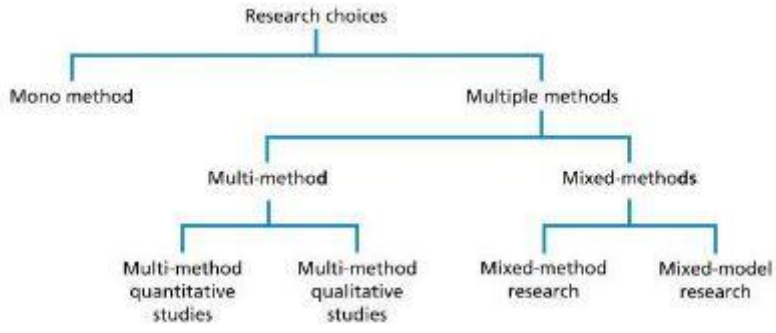

Figure 7 Research Choices (adapted from Saunders et al. 2009, 152)

To pursue this study, the investigator applied **qualitative multi-method**. After forming the research objective and questions, the author suggested that two techniques of data collection were required to obtain in-depth insights into the Finnish space industry. For a better understanding of the study subject, the researcher needed to gather secondary data (desk research) and primary data (semi-structured interviews), using corresponding analysis procedures.

Research Strategies

Research strategies take the fourth layer of the research onion. The strategies present distinct forms of investigation, an appropriate selection of which enables a researcher to answer the research questions. Typically, they are chosen in accordance with adopted philosophy and approach, amount of available time, knowledge, and accessibility of other resources. Strategies differ from each other in purposes, samples size, attitude to secondary and primary data collection, and in other aspects. All the strategies have own benefits and limitations. A researcher can employ several strategies or combine them during the investigation. (Saunders et al. 2009, 141-151.)

In order to reach the objectives of this study, the investigator needed to collect both, primary and secondary data. Primary data refers to actual information gathered by a researcher through observations, experiments, questionnaires, and other real-time data collection techniques. On a contrary, secondary data relates to the past, meaning that it was previously collected by someone else. It can be found in books, publications, journal articles, websites, and other secondary sources. (Ajayi 2017, 2-3.)

The strategy of **Survey** in form of Interview was adopted to collect primary data. In their book, Saunders and colleagues (2009, 144-145) stated that surveys were usually associated with deductive approach, and that this strategy contained quantitative data collection techniques such as questionnaires, structured observations and interviews. However, according to Ponto (2015), survey research refers to information gathering through the responses to questions by a sample of human beings. This definition does not prohibit employment of qualitative information and conforming data collection techniques such as unstructured interviews.

Thus, the researcher utilized **semi-structured interviews** that allowed to have flexible conversations with the field's experts, while simultaneously covering all the topics

necessary to answer the research questions. According to Cassell, Symon, Buehrins and Johnson (2006, 250), the format of semi-structured interviews implies having predefined themes and queries that guide a dialogue and enable interviewees to share their knowledge and experiences by answering open questions. Open questions, in turn, require a developed response, and therefore are used when a researcher wants to learn more about a subject or is unsure in reply (Saunders et al. 2009, 375).

To collect secondary data, **desk research** was conducted. The first research question, **RQ1**, could not be fully addressed within the study without using information from secondary sources such as books, internet publications, and journal articles. Therefore, the author generated a literature search strategy. The search parameters were key words: “space industry”, “entrepreneurship”, “Finland”, “funding”, etc.; databases and search engines: Google Scholar, ProQuest Ebook Central, Research Gate, etc.; and publication period: literature about space must have been written during the last 3-5 years, except for literature concerning history of the industry’s development. The researcher used secondary data to acquire greater comprehension of the space industry and corresponding concepts, to study the research background, and to examine current situation in the space sector of Finland.

Time Horizons

The fifth layer of the research onion is time horizons, or time dedicated to an investigation conduction. Researches can be either cross-sectional or longitudinal. Cross-sectional study refers to a phenomenon examination at a particular time, and allows such research strategies as survey, grounded theory or short time case studies. On a contrary, longitudinal research is applied when an investigator needs to study change and development. Hence, data collection takes a longer period of time, and is pursued through techniques such as experiments and action research. (Saunders et al. 2009, 155; Sahay 2016, 4.)

Since the purposes of the research are to explore present situation and to provide practical insights on the opportunities and obstacles private entrepreneurs currently face entering the Finnish space industry, the author conducted **cross-sectional study**.

3.3 Primary Data Collection and Analysis

The previous section of the Methodology chapter thoroughly described and justified the approaches and techniques the investigator selected to obtain answers on the research questions. Particularly, the section depicted the way of primary data collection through semi-structured interviews. The aim of this subchapter is to introduce how the interviewing process was planned and implemented, as well as to present procedures utilized to analyse gathered information.

Interview Planning and Implementation

After the research questions were determined, the investigator suggested that the most preferable way of obtaining answers would be interviewing people who had experience working in the Finnish space industry. Especially, who dealt with venture establishment in this field. To find those people, the author run an online search of local entrepreneurs, advisors, government authorities, and investors that had direct connection to the national space industry. When the list of experts was completed, the researcher used e-mails to send interview invitations (Appendix 1).

In order to get more objective answers and observe the thesis topic from several angles, the investigator attempted to invite people from several perspectives: government, space start-ups, universities, and public investors (see Table 1).

Such type of sampling, when a researcher uses own judgement to select the most appropriate respondents is called **purposive** (Saunders et al. 2009, 237-240). The researcher also utilized another technique: **snowball sampling**. In practice, snowball sampling implies asking people from the initial sample about other experts who are able to share corresponding experience and knowledge (ibid., 240-241). In the end of conversations, the researcher asked the interviewees if they knew some people she should have contacted, or if they could name top specialist in the Finnish space industry.

Besides sampling, the investigator had to elaborate the approximate structure of interviews to share with the experts at the stage of meeting arrangement. Taking the research questions into account, the three main topics for the conversations were

selected: the Finnish space industry, space ventures in Finland, and funding of Finnish space start-ups (Appendix 2). All the themes were connected by predefined questions that organically moved the conversation from the vision of the current situation of the Finnish space industry to the recommendations to entrepreneurs who are willing to enter the sector.

Considering the interviews implementation, the researcher initially stated that the approximate time to cover all the topics was an hour, therefore the time and place had to be convenient for both parties, as well as appropriate for sound recording. Before starting the conversation, the interviewees gave verbal consent on audio recording, notes taking, and either usage of their names or anonymity. During the conversations, the researcher mostly used open questions to obtain opinions and hear more information about one's experiences. Nonetheless, sometimes she used close-ended and ranking questions in order to specify the answers. Since the interviews were semi-structured, the researcher guided the dialogue by adding new questions arising from the discussions to broaden the topics.

The author transcribed the interviews within two days after the data was collected.

Primary Data Analysis

According to Lancaster (2005), the process of analysis implies turning collected information into meaningful data that assists in answering the research questions and can serve to elaborate theories and concepts. Techniques of qualitative and quantitative data analysis differ, and the researcher chooses the appropriate approach depending on the type of collected information and purpose of its analysis. (157.) Since this research is qualitative and inductive, Saunders and colleagues (2009, 502) propose a number of procedures for data analysis, such as narrative analysis, grounded theory, and data display and analysis. In this study, the approach of **data display and analysis** was applied.

Data display and analysis represents a procedure that consists from three sub-processes: data reduction, data display, and conclusions drawing and verification. At the stage of data reduction an investigator begins either summarising information or focusing on special parts of it. The main aim is to categorise and code the data, proba-

bly generating a narrative. Afterwards, the coded data must be displayed, using either matrixes or networks. The display assists in seeing relationships and patterns in the information, allows to make comparisons, draw conclusions, and verify them. (Saunders et al. 503-505.)

Additionally, the researcher utilized the other way of visual representation of qualitative data: word clouds. According to McKee (2014), this method is beneficial for investigators that aspire to notice word frequencies and reveal patterns in the text. Since **RQ3** implies analysis of recommendations given by the respondents, the author suggests that the most frequently-mentioned advices have the main impact on successful start-up establishment. In other words, the more specific recommendations are repeated, the greater number of the respondents experienced their importance.

3.4 Research Ethics and Results Verification

In order to protect wellbeing of participants and not pose risks to them, researchers must follow ethical norms and guidelines during conduction of their studies (Ruane 2016, 48). However, since ethical issues start to appear at stages of research planning, an investigator should consider possible concerns at the earliest, and continuously assess propriety of own behaviour in relation to research subjects, to their rights, and to people who could be influenced by the study (Oliver 2010, 9; Saunders et al. 2009, 183-184). The most common ethical issues are privacy of participants, their consent, non-forced involvement, avoidance of conflict of interest, safekeeping of data confidentiality, researcher's behaviour and objectivity, reactions and the impact on participants of the manner an investigator collects, uses, analyses, and reports data (Saunders et al. 2009, 185-186; Ruane 2016, 46-60).

The research ethics are considered at every stage of this investigation, from the topic and research design formulation to the data analysis and report. Firstly, all the respondents participated in the interviews voluntarily and gave their verbal consent on audio-recording of the conversations and further usage of the data. They were also asked whether to provide their answers anonymously or disclose their names and positions. Each individual was aware of the study topic and objectives, as well as received an approximate structure of an interview in advance.

Secondly, the investigator designed the study, collected information, and analysed it in a manner that did not pose unreasonable threat to the participants or cause negative consequences. The results are transparent, the transcripts and data reduction papers can be privately presented on request.

Thirdly, the researcher was open to all results independently of own thoughts and judgments. She did not use the data in purposes other than for this investigation and did not have hidden agenda. Being aware of plagiarism issues, the author acknowledged and referenced all citations and concepts that were generated by other specialists and writers.

Table 1 Research participants

Name	Position	Perspective
Bosse Lönnqvist	COO at Space Nation	Start-up
Maija Lönnqvist	Senior Legal Counsel at Ministry of Economic Affairs and Employment, responsible for Finnish Space Law and Space Policy	Public sector, legislation
Elja Kallberg	Project Engineer at JAMK UAS. Experience with Business Finland, European Regional Development Fund.	Research, University
Jaan Praks	Assistant Professor, Department of Electronics and Nanoengineering in Aalto University. Organizer of Finnish Satellite Workshop. Board Member of Reaktor Space Lab	Start-up, University
Tuomas Tikka	CEO and co-founder of Reaktor Space Lab	Start-up
Perttu Yli-Opas	CTO and co-founder of Aurora Propulsion Technologies	Start-up
Kalle Vähä-Jaakkola	CEO and co-founder of Space Nation	Start-up
Markus Ranne	Program Manager of the New Space Economy from Business Finland	Public sector, funding

4 Results

Analysis of the collected interviews showed that entrepreneurs who are planning to enter the Finnish space industry encounter resembling challenges as many founders in other areas. For instance, the research identified that space entrepreneurs find it difficult to build proper professional network, hire experienced employees and get initial funding. These problems together with competition and managerial issues are typical for majority of young ventures, and usually become the reasons for their failure (McCarthy 2017; Shane 2016). Nonetheless, there are some specifications peculiar to the space industry and to Finland, such as compulsory collaboration with other countries that operate launching systems. The obstacles and recommendations on their avoidance are presented in this chapter.

Additionally, the data provided insights on the opportunities Finnish entrepreneurs have for a space company establishment. Some of these favourable factors do not lie on the surface and were derived from experiences of the respondents, whereas others are well-promoted within the Finnish space community. The network of obstacles and opportunities is presented below (see Figure 8) and supported by description and quotes from the interviews.

4.1 Opportunities for Establishing a Space Start-up in Finland

Geopolitics

According to the findings, geopolitical situation of Finland has a positive impact on the space ventures establishment and growth. Due to neutrality of Finland at the global arena, local entrepreneurs have better possibilities to build connections with the foreign industry actors, such as the USA, China, and Russia, and maintain commercial relationships with other states. This point is supported by respondent 1:

"One of the things that could be the benefit of Finland is the geopolitical status and situation. Our CEO managed to get connections with the key stakeholders in the US and also in Russia. It would have been very difficult for, let's say French or German, just because these are so sensitive matters when we speak about space."

Respondent 5 supplemented this opinion:

"Finland is quite a neutral country, so we can sell both ways, going to anyone. I guess, some of the powers in the world understand that these guys can sell to anyone, so they need to capture that technology."

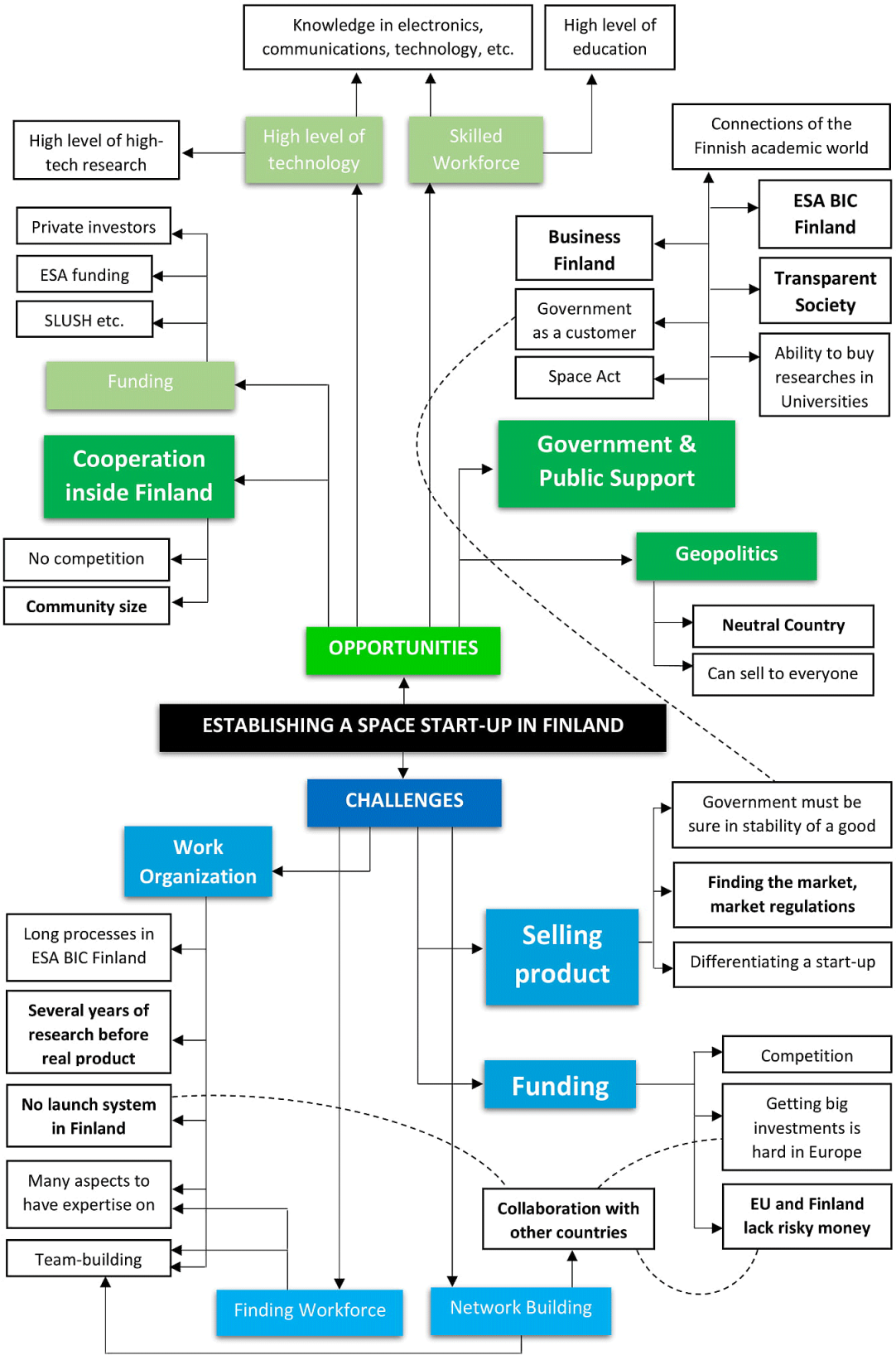

Figure 8 Data Display

Government and Public Support

Discussing advantages of the Finnish space ecosystem for a venture establishment, the interviewees acknowledged facilitation from the national public sector. All respondents noted assistance of Business Finland within its New Space Economy program. Some respondents emphasized importance of the ESA BIC Finland, and a few addressed support provided by local universities and research organizations that have global networks and ability to make tailored researches for companies. The opinion on Business Finland's facilitation is presented by respondents 6 and 2:

"Funding is a big thing from Business Finland, because basically you will be able to match the investment that you get from elsewhere. So, that's a huge boost."

"We have Business Finland, which I think is globally a very good organization, just to help to enter the market and help to receive the first funds."

Simultaneously, respondent 6 and 8 appreciated the assistance of ESA BIC Finland:

"And now that ESA BIC is here, that is of course a big thing even though it is in the very beginning stages and could work more quickly. And of course, the funding involved in that will help us, and expert assistance as well as the networks."

"ESA BIC focuses specifically on space-related companies and can provide access to technological support and assistance through the European Space Agency, so there is the added advantage that the company can get some help, other than money, relating to space."

Several respondent also emphasized transparency of the Finnish society and national legislation. Stable laws make the process of a start-up establishment and running smooth and predictable from the legal perspective. Respondent 4:

"Our regulations are alright, I mean Finland is a transparent society, rules are known, and they are in place, and nobody is going to bend these rules. If you go to the court, and then you actually can expect what is happening, that means you have something which is called trust in the society, and it makes everything easier."

Respondent 2 supplemented this opinion by pointing out the importance of the space policy of Finland:

"The Space Act sets up the framework for carrying out space activities. It answers if you are doing properly. […]. We have the space act, and a company can show that they are following it, that they have been authorized through national authorities and this should make them more convincing in the eyes of launching firms or some other cooperating partners. It's more to enhance the business, that's the aim of the act. To make the framework of the business in Finland more reliable, trustworthy."

Respondent 2 also adds that there is the other way the Finnish government can help local start-ups, it can purchase their products becoming the first reference:

"They can do first procurements. So, procure the data to be the first reference buyer of the first piece of data, just to show that it works, can be used, and it's interesting. So, they can help foster the investments but also foster the buyers."

Cooperation inside Finland

Several interviewees named cooperation within Finland as an opportunity for private entrepreneurs because of the size of the local community that enables to contact all key people of the national space industry. Smooth cooperation is also possible due to a common trend to mutual assistance and to lack of secrecy. Respondent 5 claimed that the industry actors want to collaborate rather than to compete, because they understand that successful start-ups will bring benefits to the whole sector:

"I think that it's easy to cooperate inside Finland. If you found a start-up, there are so many people and companies which are willing to support you. One of the reasons for that is probably that there's no competition and no one wants to create any competition. We are a small country, so that doesn't make sense to compete too much."

Respondent 6 and 2 commented the size of the Finnish space industry:

"Get to know people of course, like it's not as huge thing in Finland, so it's quite easy to get to know basically all people in the space industry."

"We also have quite small space community, so it is really easy to enter."

Funding

Some respondents consider public and private funding as an opportunity for Finnish entrepreneurs. Although public money that come from Business Finland and ESA BIC

are limited, they assist ventures in the beginning of their development, providing an important boost. Moreover, due to neutrality of Finland and the country's image on the global arena, not only can Finnish entrepreneurs address foreign investors, but also the interest in Finland of exterior investors grows. With creation of SLUSH and other start-up events, it became easier for Finnish entrepreneurs to match with potential stakeholders, both local and foreign. Respondent 1 shares his opinion:

"Nokia gave birth to a boom in the start-ups which has made Finland such an interesting opportunity for international investors. Like SLUSH was born here, so that's one of the big events that actually attracts a lot of global investment, and there's a lot of interest actually in Finland as such."

Respondent 1 and 6 commented on funding based on their experiences:

"But generally, funding any company in Finland is rather straightforward and easy."

"And it's really easy to find investments in Finland. [...]. If you are a Finnish company doing some harsh technology, you are trusted and you will get money from external sources also."

Skilled Workforce & Technology Level

Additionally, several respondents mentioned that Finland has skilled workforce due to strong education system and expertise in technical and digital areas. This opinion implies having proven specialists in different industries, but it does not mean that these people are easy to get for a starting firm. Respondent 1 claimed:

"First of all, there is a good potential of skilled workforce. There is at the moment in software and in electronics, in communication technology, due to the background of Nokia, but also due to the emergence of big players in the gaming software side."

Respondent 2 supplemented this opinion by noticing high technology level of Finland and strong knowledge basis:

"Finland has quite good technological base anyway, we're strong in digital sector, we also have good knowledge, good people, good background, good education. […] But I think that the technology and the knowledge basis are the strong points of Finland."

4.2 Challenges in Establishing a Space Start-up in Finland

Work Organization

The research showed that space entrepreneurs in Finland encounter obstacles similar to those that are common for the majority of young ventures, and work organization is one of them. Nonetheless, there are some specifications that are peculiar to the space industry and to Finland. For example, Respondent 2 fairly acknowledged the lack of launching system in Finland, meaning that the space entrepreneurs, in case they work with the upstream segment, have to consider cooperation with other countries in advance, turning it into an inherent part of the work:

"But of course, we cannot launch in Finland at the moment, so anyway you have to go to collaborate with other countries."

Respondent 6 also noticed the time-related issues and warned entrepreneurs about the possible period needed to conduct a research:

"But then, I guess, just that typical start-up stuff: how you organize work and how you manage the whole thing. Because of course, in space tech, it's at least two or three years of research before you have any product, so it's already had a stack, and you need to be able to concentrate the research on correct topics."

Finding Workforce

The challenge of searching for the right people is also a part of work organization, but the researcher decided to distinguish it due to the frequency with which the obstacle appeared during the interviews, as well as due to emphasize the respondents gave to the problem. Respondent 4 commented this issues:

"You face also the problem of, although we have a very well-educated society, it's still that workforce is not easy to find. So, there are certain limitations also. Not everybody wants to live in Finland and if you start to look for a very specific engineer with a very specific skillset, it might be that you find these few guys in the world and they already have a very nice working place somewhere where sun is shining all the time."

Respondent 6 supplemented this position, highlighting importance of having diversified team with variety of competences:

“I mean, we need to look for expertise in very many areas, because there's electronics, there’s manufacturing […]. Compared to a software start-up: it's enough to have two guys that know how to code, but in space you will need a lot more people that know a lot more, like variety of topics, so that they can actually handle all the different aspects.”

Network Building

Networking is one of the most crucial aspects of entrepreneurship. Building right connections enables entrepreneurs not only to find the team and investors, but also to enter the global arena and to solve specific problems arising during the company establishment and running. Hence, networking is tightly bridged with all the challenges presented in the research. However, building professional network is not easy and considered as a challenge by many entrepreneurs. Respondent 7 shared opinion on this issue, emphasizing that strong bonds take time and patience:

“*Networks are very important. You need to nourish them, and that takes time. You need the lifelong things like friends and love, and it dies, if you don't nurture it and foster. […]. Networks is always a number one challenge. I think it is the major challenge in Finland because of the cultural norms and those kind of things.”*

Selling Product

One of the main challenges pointed out during the conversations was identification of customers and market needs. For instance, companies cannot merely build and sell satellites. Firstly, due to advancement of technology, it became affordable for even small ventures. Secondly, because countries that operate launching system do not necessarily have capacity to launch all the objects. Moreover, sustainable usage of space and discussion on the space debris invoke to send to space only the objects that have clear scientific goal or further Earth applications, therefore entrepreneurs must have explicit vision of what they do and for whom. They should see the market need, but in the space industry, sometimes it is difficult, and Respondents 5 and 6 supported this position:

“You really need to have in mind what the customer actually will need. We are a satellite company, but our customer probably doesn't need to have a satellite. So, it

doesn't make any sense to try to sell a satellite to the customer. What they actually need is to have the information what the satellite can provide."

"Challenge… for us it was identifying the product need."

Respondent 3 and 2 noted that it is not only complex to identify customer needs but also difficult to sell the first product:

"*But at the very first steps just to sell your idea – I think that this can be quite hard."*

"Then, one maybe is how to sell your first product. So, if you get data from your satellites, who will buy that?"

Considering specifics of different markets, Respondent 4 added:

"Another problem in Europe generally is also the market, because some of the areas are regulated so tightly, without competition rules and all the other rules, that you cannot sell easily your products which might be very good."

Funding

Although the interviewees considered Finnish public and private financial sources and infrastructure for matchmaking as an opportunity for a start-up development, some respondents also mentioned tightening competition for getting funds, lack of risky money, and comparing to the USA and China, small investments. Respondent 4 commented the potential of getting substantial investments in Finland:

"The main challenge is probably the venture capital. It's concerning the whole Europe. We don't have this kind of risk-taking, brave money so much as we have in the Silicon Valley. […]. If you want to build a fleet of satellites and you need tens of millions, then it might start to be a bit unrealistic to get all this money from Finland, because there are not so big investors in Finland. […]. So, it might be that local investors are more securely putting their money with less risk but maybe also smaller revenues."

Respondent 1 supplemented this position:

"If you look at the volume of money, so we're talking about something that in Finland is a big investment, like 4 million on the table, that's a huge investment. But if you go to the US, it's small. The big money is in the US: raising money they usually talk in

tens of millions rather than a few millions. The scale is different, therefore it is easier to get smaller investment that can be in the range of a big investment."

Moreover, before applying for public funding in Finland, entrepreneurs must have own funds that also could be problematic. Respondent 8 agreed:

"I think in the very early stages, the challenge is the lack of own funding, that's mostly the problem, or lack of seed funding on your own side."

4.3 Recommendations on Obstacles Overcoming

In order to identify the most frequently given advices, the word cloud was generated (see Figure 9). The word cloud shows that the respondents provided variety of recommendations. However, this subchapter is aiming to present the most common. The full list with recommendation can be found in Appendixes (Appendix 3).

Figure 9 Word Cloud: Recommendations

To begin with, the **international team** advice implies addressing foreign specialists in order to solve the problem of team-building. Despite of the fact that Finland has the proven education system and qualified workforce, there can be difficulties in inviting the experts into a start-up, because they are likely to already work for stable corporations with sufficient salary and lack of uncertainty. Respondent 1 commended:

"Finding a right team… again, here I think you need to look outside Finland as well."

The other recommendation the interviewees provided is to search for **market need** in advance and develop those products that have potential to be sold. Respondents 6 and 4 claim the importance of timeous market need identification, and believe that in order to define customers and their needs, it is necessary to merely talk to other actors of the space industry:

"Because the space industry is kind of small, there's not that many players compared to other industries. So, to know what the customer needs, you actually just need to know people from other companies and ask if they need this kind of product."

"You cannot be a company whose most important goal is just to go to space, because it's cool. You need to provide something which can be sold and, also, you have to make sure that there are enough companies or customers who want to buy this product, so there needs to be a market."

Applying for funding in Finland has own specifics and limitations, such as the amount of available public and private money and less risky approach of the majority of investors. The feature of the space industry start-ups, especially of the upstream segment, is some extent of uncertainty of the revenue, therefore the investors and venture capitalists that aim to finance stable companies with predictable profit are less likely to support space entrepreneurs. Hence, the interviewees recommended not to focus on the local funds, but search for **foreign investors**.

Respondent 1: *"You can go regional, global, or to some of the big markets. Chinese area, there is a lot of Chinese investors and there is big money involved."*

Respondent 5: *"In the US it might be easier to found a new space start-up, because the private funding, venture capital funding is much easier to get in the US. That's just*

so much more going around and they're willing to fund more risky start-ups, even you can have just an idea of what you want to do, and you can raise millions of money."

Respondent 4: *"Business Finland is just one instrument in your portfolio, but Business Finland for sure is not able to pump up an entire big company like Iceye, because, firstly, it's too high-risk to put all these public money to one company, and secondly, it's just like they have other things to do with this money as well."*

Respondent 6 highlights **transparency**, advising to be open and disclose ideas to people working in the same industry in order to get valuable criticism, recommendations, and expertise from more experienced colleagues:

"And ask around, be open with what you are planning to do. I don't think that there would be a place for a company that would develop something in secrecy and then tell that: "we have this product now, please buy it". Because it's impossible to know what is actually needed and what other companies are developing. So, you need to openly discuss what you are planning, and be able to define the whole business case through open discussion."

The majority of obstacles that entrepreneurs face can be solved with help of right connections. Importance of professional **network** was highlighted by all the interviewees with accent on global cooperation. In other words, the entrepreneurs that are aiming to grow their companies and get bigger private funding from countries like the USA or get new international employees, need to have connections in these states, either own or network of their stakeholders. Respondent 1 comments:

"Since we are a small country, we cannot do something that is big. Therefore, you should get in touch with the big players, getting filled the networks and contact to those because those are key in this industry."

Respondent 1 also adds:

"Usually the beginning entrepreneurs, when we are thinking about setting a company, should think about what kind of advisors, network you need. You need a board of directors, you might be able to have in the board that advisors. Senior or matter of expertise advisors that can guide you and have own important connections."

Respondent 3 supplements this position and invokes entrepreneurs to think about cooperation with local institutions:

"I would like to recommend contacting universities. If you see that university can help you in anyway, ask. They can say no, or yes, or that they can have a look. Because the more I know about different kinds of ideas, the more I know that don't know enough. But maybe I've got connections to get them to move on."

5 Conclusions

5.1 Research Question 1, Available Support

What are the options for growth acceleration and financial support available to private entrepreneurs in high-technology sector, globally and in Finland?

To begin with, there are variety of methods and entities that can provide either public or private funding to entrepreneurs who enter the high-technology industries. Although some programs are country-based, meaning that ventures must be registered in the state to use offered services, there are many global events, competitions, investors, incubator and accelerator programs (Starburst, TechStars Accelerator, etc.) that can support and finance companies regardless geographical location. Therefore, in case entrepreneurs want to start business in the high-tech sector that is traditionally considered as risky, time-consuming and capital intensive from R&D and other perspectives, they can use foreign connection to get investments, specific assistance, and additional support. However, even addressing the first financing organizations, entrepreneurs must have own seed money.

In Finland, to get first financial and advisory support, entrepreneurs can address Business Finland. According to the findings, this public growth accelerator is a popular option among local space entrepreneurs that consider the organization as a proven channel of funding and assistance during the early stages of a company development. Finnish high-tech entrepreneurs can also benefit from participating in various incubators, some of which are held on basis of universities. Besides, taking part in events such as SLUSH may bring additional interest to ventures from local and foreign investors as well as from potential employees.

5.2 Research Question 2, Opportunities and Obstacles

What are the opportunities and obstacles of establishing a private space start-up in Finland?

When an entrepreneur decides to start a space-related company in Finland, there is an ability to utilize supporting options provided by local companies, private investors, or the public sector. These options are either apparent or hidden, and they may have straightforward implementation or act as favourable factors for a venture's growth. One of the most important and visible opportunities entrepreneurs get in Finland is governmental and public assistance. The public instruments for start-up endorsement include funding, connections, research facilitation by universities, premier procurement, and other less obvious tools such as transparent regulations that enable to have legally stable and predictable company development.

Having the world's proven education system and being one of the technologically advanced countries, Finland continues developing these areas whereas local colleges and institutes teach and graduate skilled specialists in a variety of fields. The expert workforce and high technological level are the other favourable factors that entrepreneurs can take advantage of establishing a space start-up. Moreover, the cooperation and network extension inside Finland is not difficult due to size of the local space industry, and also due to the tendency to collaborate rather than to compete. Since networking is one of the major aspects that may influence the way of a company growth, being able to access many industry's actors and make connections is crucial for entrepreneurs.

Finnish geopolitics is not a straightforward opportunity, but the stable and neutral position of the country at the global arena enables local entrepreneurs to have discussion with different states, build networks there, and maintain commercial relationships. For instance, the local companies have potential to get partnership with NASA as well as with Russian or Indian organizations. Geopolitics, also, influences funding: since Finnish entrepreneurs can establish connection with the foreign big parties in the space industry, they may also receive funding from abroad. Nonetheless, Finland itself offers financial support to start-ups via Business Finland, and there

are private investors' and ESA's funding available, therefore the local investment instruments also serve as an opportunity for entrepreneurs.

However, the research showed that funding is a controversial topic, and even though there are good chances to receive seed financing in Finland, it might be not enough for a start-up growth. The European Union and Finland lack the amount of risky money that, for example, the USA have, and therefore it might be a challenge for local entrepreneurs to get big investments without addressing foreign countries.

The other controversial topic is finding the workforce. Although Finland has skilled professionals, it is not easy to get them into start-ups, as they are likely to work in bigger companies operating in corresponding areas. Furthermore, building a space company requires employees with different competences, and it is not only difficult to find right people, but also hard to manage such diversified team.

Managing employees is part of work organization that is also perceived challenging by some entrepreneurs. For instance, entrepreneurs have to consider the fact that in Finland, there are no launching systems, and in case they are planning to work with satellites, they need to cooperate with other countries. They also must consider that the research process may take several years before manufacturing the actual product. Moreover, the time required to go through ESA BIC and Business Finland applications, or through quality checks of ESA, also should be taken into account.

Identifying the market needs and selling own product are the other challenges space entrepreneurs encounter. Building a company, appropriate differentiation is vital for its success, as well as conduction of a market research with an aim to ensure that there are enough customers. Additionally, in the space industry, sometimes it is difficult to define market and sell products or services to specific areas since they are tightly regulated by governments. Therefore, the question of market and customers' needs determination should be also considered in advance, during the early phases of a venture establishment.

Networking is also considered as an obstacle itself, because not all entrepreneurs feel comfortable building connections. Hence, communication skills and bold thinking may be personal challenges for some individuals who attempt entering the space industry of Finland.

5.3 Research Question 3, Overcoming the Obstacles

How can the obstacles be avoided or overcome?

Although the interviewees provided a recommendation list on aspects entrepreneurs should consider in order to avoid the presented above obstacles, there is one advice that covers all those problems and helps to solve them: network.

Indeed, all the respondents noticed importance of right connections for a company development. Not only the networks in foreign countries are the key to receiving bigger investments, but also to building skilled team, to finding customers, to smoothening the bureaucracy processes, to getting additional expertise on the matters, and to collaborating with other countries that is essential for the space industry.

Hence, the main recommendation to either avoid or solve the problems pointed in the previous sub-chapter is to build professional network. However, entrepreneurs should appreciate the fact that one person cannot build such diversified network, and therefore, they need to consider which consultants and key connections are necessary to successfully start and run the company. Then, surrounding themselves with appropriate advisors and building strong relationships with them, entrepreneurs get access to network of these people, and hence are able to use these connections for the further start-up growth.

6 Discussion

6.1 Research Reliability and Validity

In order to obtain appropriate answers on the research questions and consider the research quality, the investigator addressed the notions of validity, reliability, and data saturation. According to Saunders and colleagues (2009, 156), reliable study implies employment of such data collection techniques and analysis procedures that lead to consistent results. In other words, research is reliable when other observers on distinct occasions are able to produce similar findings. In case of this study, the researcher attempted to reduce the common reliability threats in form of bias and errors by providing the respondents with an ability to give answers anonymously, by

creating an approximate structure of interviews to guide conversation, and by ensuring transparency of data analysis.

During the data reduction, the interview transcripts were read and the quotes that directly or obliquely addressed the research questions were highlighted. These papers can be presented on request. Moreover, to get more objective and complete results, the researcher scrutinized the research topic from several angles by conducting interviews with experts from different areas of the Finnish space ecosystem: local entrepreneurs, representatives of governmental programs, and of other public actors.

Nonetheless, since the researcher used non-standardised qualitative methods and the results are related to reality, there is a possibility that the findings cannot be duplicated (Saunders 2009, 327-328). However, the researcher suggests that since the findings are partly similar to the common studies on entrepreneurship that describe challenges and possibilities for starting a company, but with some specifics peculiar to Finland and to the space industry, the investigation can be called reliable.

Validity, on the other hand, refers to a concern whether the data collection methods measure that they supposed to measure, and whether the study results show what they appeared to show (Saunders et al. 2009, 157). In other words, validity verifies if an investigation answered research questions (Kananen 2011, 66). In terms of this study, collected and analysed secondary and primary data enabled to give precise answers on the research questions, meaning that the author used appropriate information and sample, as well as followed the research design.

In addition, data saturation can be considered as the other prerequisite to the research quality. According to Saunders and colleagues (2009, 590), the term refers to the research phase when additionally collected data does not provide new insights into the field, or hardly a few. In this investigation, data saturated after five respondents were interviewed, and new conversations either reinforced the ideas mentioned before or provided not numerous new insights.

6.2 Research Implications

Comparing the findings derived from primary data with information from secondary sources presented in the Literature Review chapter, some similarities and additions

can be found. The research results confirmed that the main support for technology start-ups, particularly, for space-related firms is usually provided by governments. Indeed, in Finland, the public sector in form of universities, ESA BIC, Business Finland, and transparent legislation is the main facilitator and assistant of companies operating in the high-technology industries. Therewith, the results confirmed that entrepreneurs address public actors to receive support during the early stages of start-up development. Additionally, some responses supplemented the secondary data on the European Union's and Finnish investments: there is lack of risky money and public money are limited. Hence, to receive substantial funding, entrepreneurs should consider going to foreign private investors.

Summarizing, the research results are at some extent similar to other studies about entrepreneurship: there are the common funding issue and managerial difficulties. However, the study defined specifics peculiar to Finland and to the space industry, such as geopolitics and community size. Therefore, the research has contributed into the topic of a space start-up establishment in Finland not only by providing experiences and advices of the present actors, but also by creating a clear summary with opportunities and supporting factors entrepreneurs have, obstacles they can encounter, and recommendations on how to overcome those challenges. Such scheme can be beneficial for entrepreneurs who plan to enter the space industry of Finland.

6.3 Ideas for Further Research

The space industry is a wide topic from legal, technical, scientific, and business perspectives, and therefore, there are numberless directions for further investigations. However, in order to deepen the research topic, the space industry and ecosystem of the European Union can be studied. Since in the EU, there are specific instruments to the space companies support and boost as well as some European members have more developed upstream segment comparing to Finland, the investigation may identify unique features and favourable factors for space start-ups development. Likewise, the research on the European space industry may provide more insights on challenges typical for some members of the EU that have different regulations, technology level, geopolitical situation, signed treaties, cultural and historic backgrounds.

The main recommendation for conducting such investigation is to look at the topic from different perspectives. The sample should include not only entrepreneurs with their experiences, but also the active private investors who finance space ventures and can provide knowledge and opinions on their successful and failing projects. Moreover, interviewing representatives of public sector, such as government workers responsible for space regulations or employees of public financial institutions, can enrich the research with the state's vision of the space industry development.

Furthermore, one of the recent trends in the space industry is the problem of space debris and sustainable utilization of space. Since the topic is under discussion, there are no common understanding of the market value of debris removal systems. Hence, pursuing an exploratory study on the methods of making space utilization more sustainable as well as on the potential market and factors influencing creation of such market, researcher may get important theoretical findings which can be practically implemented in the future.

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Appendixes

Appendix 1. Invitation Letter

“Dear Recipient,

My name is Iuliia Okhrimchuk and I study International Business at JAMK University of Applied Sciences. Currently, I write my bachelor’s thesis under the supervision of Prof. Juha Saukkonen. The research addresses opportunities and challenges that entrepreneurs face entering the Finnish space industry. I mainly focus on issues concerning funding reception, but I am open to any findings regarding space start-up establishment in Finland.

Hence, my aims are to identify the possible problems people can encounter during their space company development and provide specific recommendations on how to avoid or overcome them, as well as point out the possibilities for the growth.

For this reason, I would like to ask an hour of your time and invite you to an interview. I believe that you have some valuable opinions and experiences you could share, and I will be very grateful if we agree on a meeting at the mutually convenient time and place.

As I am planning to conduct a semi-structured interview, I cannot send to you a precise list of questions in advance. However, I can share the structure and topics that should be covered during the conversation. In case you agree, I would also like to audio-record the interview with a purpose to transcribe it, but whether to give a consent or not depends on you. It also up to you if I must keep you name or provide your opinions anonymously in the final research paper.

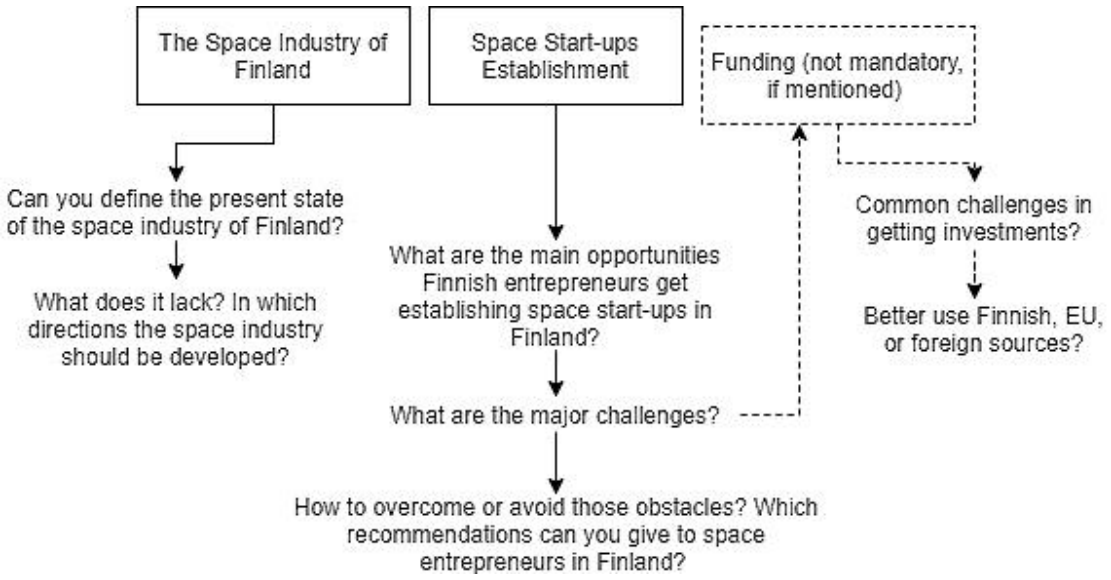
In case you have any questions, ethical concerns, or want to know more details about the research topic and the interview structure, please, just write to me (K8449@student.jamk.fi) and I will answer as fast as I can.

Looking forward to your reply.

Sincerely,

Iuliia Okhrimchuk “

Appendix 2. Semi-structured Interview



Appendix 3. Recommendations Quotes

OBSTACLE	RECOMMENDATIONS
WORK ORGANIZATION (INCL. FINDING WORKFORCE)	"I would say that you don't always have to raise funding to make a successful start-up. That's the first thing. If you get at least some seed funding, you can develop your product with that and go straight to the revenue." "Finding a right team… again, here I think you need to look out-side Finland as well." "Compared to a software start-up, it's enough to have two guys that know how to code, but in space you will need a lot more people that know a lot more, like variety of topics, so that they can actually handle all the different aspects." "And ask around, be open with what you are planning to do. I don't think that there would be a place for a company that would develop something in secrecy and then tell that: "we have this product now, please buy it". Because it's impossible to

	know what is actually needed and what other companies are developing. So, you need to openly discuss what you are planning, and be able to define the whole business case through open discussion.”
FUNDING	“You can go regional, global, or to some of the big markets. Chinese area, there is a lot of Chinese investors and there is big money involved. They require different approach and you definitely need to have patience and you need to build connections in very much different way than in the US. The Chinese usually take couple of years to build the relationship, so don't expect any quick wins there.” “In the US it might be easier to found a new space start-up, because the private funding, venture capital funding is much easier to get in the US. That's just so much more going around and they're willing to fund more risky start-ups, even you can have just an idea of what you want to do, and you can raise millions of money.” “Business Finland is just one instrument in your portfolio, but Business Finland for sure is not able to pump up an entire big company like Iceye, because, firstly, it's too high-risk to put all these public money to one company, and secondly, they have other things to do with this money as well.” “Through crowdfunding you can obtain fair amount of funding as well.” “The major things that the investors will look at is the idea and the team. Interestingly enough they will appreciate the actual business case less, because most of them have probably seen millions and millions of old business cases.”

	"In Europe, we have very nice public opportunities to get start money from government, so you get very good loans, you get different kinds of accelerators, incubators and so on."
SELLING PRODUCT	"Because the space industry is kind of small, there's not that many players compared to other industries. So, to know what the customer needs, you actually just need to know people from other companies and ask if they need this kind of product." "You cannot be a company whose most important goal is just to go to space, because it's cool. You need to provide something which can be sold and, also, you have to make sure that there are enough companies or customers who want to buy this product, so there needs to be a market." "You really need to have in mind what the customer actually will need. We are a satellite company, but our customer probably doesn't need to have a satellite. So, it doesn't make any sense to try to sell a satellite to the customer. What they actually need is to have the information what the satellite can provide." "And especially regarding the small satellites, you should have multiple satellites in the orbit: if you sell one satellite to the customer, it doesn't make any sense to have a small satellite, but if you actually have yourself operating the huge constellation of satellites, you can provide much better information."
BUILDING NETWORK	"Since we are a small country, we cannot do something that is big. Therefore, you should get in touch with the big players, getting filled the networks and contact to those because those are key in this industry."

"Usually the beginning entrepreneurs, when we are thinking about setting a company, should think about what kind of advisors, network you need. You need a board of directors, you might be able to have in the board that advisors. Senior or matter of expertise advisors that can guide you and have own important connections."

"I would like to recommend contacting universities. If you see that university can help you in anyway, ask. They can say no, or yes, or that they can have a look. Because the more I know about different kinds of ideas, the more I know that don't know enough. But maybe I've got connections to get them to move on."

"Usually, you will find from people that are quite close to you the right connections who are able to help you. Acknowledging that you can't do that all yourself, you need help – this is the key advice. Don't be afraid of that and don't try to do everything yourself."

"I guess: get to know people of course, like it's not as huge thing in Finland, so it's quite easy to get to know basically all people in the space industry."

"Business Finland also wants to offer the companies the opportunity to create networks."