Open innovation in the Dutch space-sector
towards an open innovation business model

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Open Innovation in the Dutch Space-Sector
Towards an Open Innovation Business Model

by
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Open Innovation in the Dutch Space-Sector

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Case setting:     Space policy
Deep space by Nick S.W. Smaling

In deep space, in a universe far far away from ours, a strange species tries hard to explore the space.

They created big white birds with funny names, like USA, ESA, or NASA searching for new gains.

In their quest to discover their unknown, the planets in their galaxy, conquered by gravity.

They follow outdated scientist like Einstein, Darwin and Newton, proven wrong ages for our civilization begun.

In order for them to move on, they should never stop questioning, because curiosity is the reason for existing.

Their so called gravitation isn’t the reason for them to fall in love, we wish them the best flying as a dove.

Your time is limited, so don’t waste it living someone else’s life. Don’t be trapped by dogma — which is living with the results of other people’s thinking. Don’t let the noise of others’ opinions drown out your own inner voice. And most importantly, have the courage to follow your heart and intuition. They somehow already know what you truly want to become. Everything else is secondary.” - Steve Jobs (1955-2011) R.I.P.
Preface

This report is the result of my master thesis project, performed in partial fulfillment of the requirements for the degree of Master of Science in Innovation Management at the Eindhoven University of Technology. In the beginning of 2011 Dr. Christina Giannopapa offered me a great master thesis project at the ESPI, which is the European think tank which provides decision-makers with an informed view on mid- to long-term issues relevant to Europe’s space activities. The main topic she brought up was open innovation and how open innovation should be improved in the space-sector. Before the project actually started I showed my preferences to my mentor, Isabelle Reymen, which were open innovation and business models. This was a great chance for me to combine my interest and expertise to start with this challenge. For me, this was the first time that I worked exclusively on such a huge single project, and it wouldn’t have been achieved if I didn’t have the help of some people, who I would like to thank.

It all started with the collaboration with Isabelle Reymen, who finally was my master thesis supervisor mentor. I liked her courses she presented at the master Innovation Management and I deepened myself in her research. This was the final breakdown for me to work together. In the project she helped me with my weaker points, and she helped me improve myself to do scientific research. Especially she supported me with structuring and organizing the data, which was a point of attention for me. Furthermore I would like to thank my second supervisor Elco van Burg, which helped me first of all to get in touch with Christina Giannopapa. Furthermore he helped me with generating new ideas. His inspiring way of getting out of the box, and digging further into the problem helped me a lot to reach my final redesign direction. I would also like to thank Christina Giannoapapa, who facilitated me this wonderful project, which fitted perfectly to my personal and scientific interests. She provided me with important data, and people to speak with in my data collection phase. The people who helped me to get data from the companies, I would like to thank at last. Without them the research wouldn’t be as grounded as it is now. Almost all of the companies were willing to co-operate with the interviews.

Personally I would like to thank my friends and family who supported me through this tough period. My parents helped me throughout this period; together with my girlfriend they provided tremendous love for me during this project. Finally I would like to thank ir. Bart Wieleman who helped me generating ideas, and Youri Immerzeel who final edited the thesis.

I am very proud what I have realized in the last six months, and I hope that this thesis is the starting point for more research in this area. Finally I would like to say that this thesis contributed to an insightful path of life, and made me realize how important it is to communicate, work thoroughly efficient and have regular loops with all stakeholders to achieve a common goal.

Nick S.W. Smaling

IJsselstein, January 2012
Executive Summary

Research questions and set-up

This study looked at open innovation in the Dutch space-sector business model-wise. The main goal was to find out how open innovation could be more frequently used in this sector, and how business models could contribute to more open innovation. This question was brought up by the European Space Policy Institute (ESPI), which is a European think-tank focussing on space-sector issues located in Vienna. In close collaboration and co-operation with the ESPI the aim was formulated to develop an open innovation concept for the space-sector in Europe. In order to distinguish the main questions, the four following research questions were set up.

1. What does the current business model in the European and Dutch space-sector look like?
2. How does the business model, focusing on open innovation, of the Dutch space-sector differ from the business model of high innovative sectors?
3. What can be done to re-innovate this current business model of companies in the Dutch space-sector?
4. How can the ESA, the EC and the Dutch government stimulate the market to get more benefits from open innovation?

The study followed the regulative cycle described in the business problem solving handbook of Van Aken et al. (2007) and it started with a literature review. A literature review was carried out in order to collect tools for a toolbox that could help the interviewer to carry out the interviews. Furthermore, a theoretical background was created which helps to place the problem in a certain perspective. Business model literature was inspected for their usefulness and the generic business model of Osterwalder (2010) was used as starting point. It decomposes a business model into nine different aspects (Value proposition, Partner network, Client relationship, Client segment, Key resources, Distribution channel, Cost structure, Revenue flow). These nine different aspects were interesting, as these were the adjustable factors of a company. Literature was consulted on how these nine different aspects of a business model could be filled in, in order to foster open innovation in that company. Furthermore, literature analysis was carried out to find how business model innovation should be arranged. The literature review section was finalized by reviewing two different types of open innovation. On the one hand, there’s formal R&D collaborations, which is a relationship based on collaborating with one another. On the other hand, there’s selling and buying technologies, which are scientifically defined as inbound and outbound innovation. The final part of this section formulates design principles on how open innovation should be achieved. Data collection was the next phase that was executed. Data was primarily collected using two main methods; respectively semi structured interviews and though sector relevant data collection. The interview consisted out of three main parts. Firstly, the nine business model aspects were inspected. Secondly, external aspects (Political, Economical, Social, Technological, Legal, and Ecological) were questioned. Thirdly, innovation indicators were an area of interest during the interviews. People that were interviewed can be grouped into three categories, business model experts within the space industry, space industry experts like experts at TNO or the NLR and companies that not in active in the space-sector were consulted. Finally, fourteen interviews were conducted at space companies and six interviews were held at companies in the non space-sector. Finally, other data was used, which was mainly collected by reports and presentations from space companies, institutes and agencies.
The data analysis consisted out of scientifically dealing with the collected interviews. Half of the interviews were transcribed and the other half was summarized. All conducted interviews were coded. Selective coding was used in order to have to have a framework up front, supplemented with open coding the data was analyzed.

**Analysis and redesign**

Based on the data collected, the European and Dutch space-sector were sketched. The ESA is the coordinating agency that facilitates companies and institutes to do business in space. Looking at open innovation, the ESA tried to stimulate this in three different ways, namely the innovation triangle initiative, the network partnering initiative and the technology transfer programme. In the Dutch space-sector approximately one thousand people are working in twenty companies, and around five companies are dedicated to space solely. The internal analysis looked at the nine different aspects of a business model individually, but also multi-dimensionally. It found out that the focus of the company determines how the rest of the business model is dealt with. Empirical evidence suggests that there might be a triangle linkage between key activities, key resources, value proposition and client relationships. Another interesting relation was found between indirect distribution channels and customers relationships. Literature expected that indirect distribution channels were good for open innovation, but empirical evidence mentioned that direct distributions channels might work better. A final finding from the internal analysis was that companies should look for efficient ways to bundle strengths by means of looking for the complementarity in their business models. Externally, six different aspects were evaluated based on the collected interview data, and a cross-dimensional analysis was also carried out.

This analysis resulted into two groups of problems that should be tackled. The first group of problems that should be targeted is located at the ESA. They focus mostly towards inbound open innovation. This is complemented with the finding that the ESA seems more directed towards established companies in the space, which makes it hard for smaller companies to acquire knowledge. These two problems need to be targeted in order to benefit more from open innovation in the space-sector. The second group of problems was found at SME’s in the Dutch space-sector. SME’s should play a more active role in stimulated open innovation in the space-sector. Most of the SME’s that were active in the Dutch space-sector were start-ups that possess a technology, and try to apply it in space. They were very active in R&D and setting up innovation programs. This leads to a strategy which is called product leadership and is, according to the literature, disastrous for open innovation. These problems led to two different solutions directions, namely the design of a generic open innovation business model and guidelines for the ESA.

The generic open innovation business model is made by combining literature and empirical findings regarding aspects that foster open innovation, into the standard model by Osterwalder. It is showed in figure I. Not every company could and should use all aspects at the same time, so preset configurations were designed. Customer orientation focusses on building a relation with the customer and letting the customer participate in the open innovation process. Exploiting innovation deals with how to make use of innovations, for example by means of licenses. Network orientation is the last alternative which deals with setting up close relationships with partners in order to conduct more open innovation. The generic open innovation business model and the alternative configurations were tested at four companies, and most of them were very enthusiastic and helped
to improve the model as it is now shown in figure I.

Finally, guidelines for decision and policy makers were made including the ESA, EC and the Dutch government. The first guideline is making use of knowledge database. A general database should be set-up with all projects ever carried out, so that companies could look if they could do anything with previous innovated technologies. The second guideline is to make use of open source software. An open source platform would bring companies together, and facilitate companies' work to work together, while they would "speak each other's language". Finally these institutes should focus more toward SME's, and they should look if they could exploit open innovation outside the space-sector.

**Osterwalder Business Models**

<table>
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<tr>
<th><strong>KEY PARTNER</strong></th>
<th><strong>KEY ACTIVITIES</strong></th>
<th><strong>VALUE</strong></th>
<th><strong>RELATIONSHIPS</strong></th>
<th><strong>CLIENTS</strong></th>
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<td>- Close contacts with customer and partner relations</td>
<td>- Not focusing on solely development activities</td>
<td>- Not solely product leadership</td>
<td>- Balance CRM tools and personal contacts</td>
<td>- Create informal and open settings with customer and research partners</td>
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<td>- Base contact frequency on project phase</td>
<td>- Focus key activities &amp; R&amp;D outside the company</td>
<td>- Customer oriented value proposition / or a mixture of value propositions</td>
<td>- Criteria for partner selection</td>
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<td>- R&amp;D test project with partners</td>
<td>- Open source software</td>
<td>- Complementarity values should be brought together</td>
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<td><strong>KEY RESOURCES</strong></td>
<td><strong>COST CENTRES</strong></td>
<td><strong>VALUE ADDED RESSELLERS</strong></td>
<td><strong>CHANNELS</strong></td>
<td><strong>REVENUE STREAMS</strong></td>
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<td>- Open source software</td>
<td>- Innovation costs should be assigned project dependent</td>
<td>- Value Added Resellers</td>
<td>- Several distribution channels</td>
<td>- Use patents and shared patents</td>
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<td>- Use resources to innovate together outside the space sector</td>
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<td>- Exploit patents by means of licenses</td>
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<td></td>
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<td>- Use of subsidies in open innovation projects</td>
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![Figure I. Adapted from Osterwalder (2003) schematic representation of a business model, filled in for maximizing open innovation](image)

**Conclusion and discussion**

Concluding this study integrated business models with open innovation principles, by answering all the research questions. Scientifically this study made steps in combing business model literature with open innovation principles. Practically a generic open innovation business model is designed, with different alternative configurations for SME's. Furthermore guidelines for the decision and policy makers including ESA, EC and the Dutch government were set up, which can be implemented in order to benefit more from open innovation. Further research should look at how the business models should be implemented at different companies, and what alternative is suitable for a specific type of company. Finally a remark should be made that the study has some limitations, which were insurmountable, but they were studiously dealt with.
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1. Introduction

The space-sector requires errorless technological advancements and pushes technological knowledge boundaries beyond what we know today. In recent years, the Space-sector exhibits the signs of a mature sector where innovation is mostly incremental rather than breakthrough and mostly stems from breakthrough innovations in other sectors like ICT.

Currently, Europe’s political and economic trends for the space-sector are highlighted the recently adopted Lisbon Treaty, the new “era of i-conomy” and the “Europe’s 2020” strategy which set the basis for the space-sectors future in the European Union with emphasis on innovation. In particular, the Lisbon Treaty calls Europe to build up the Unions space capabilities as a shared competence. On 5 March 2010, the Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn created the term ‘era of i-conomy’ (innovation economy) at the Innovation Summit of the Lisbon Council and on the 17th June the Europe adopted the new 10 year strategy of the Union; the “Europe’s 2020”\(^1\) strategy where one of its vision is to be a “union of innovation”.

The European Commission with its Horizon 2020 programme and the European Space Agency (ESA) with its own programs are tasked to build the Europe’s space-sector together with national agencies. The investments and time required for research and technology in this sector call for an open innovation model. The European Space Policy Institute (ESPI) has recently conducted a study on “Key Enabling Technologies (KET) and Open Innovation. New Impulse for the Space-sector”\(^2\). The ESPI study provides the basic framework for the space-sector to make strategic partnerships and share the high costs related to innovation by making key enabling technologies as the center piece for cooperation. It has become evident that the space-sector needs to develop in a systematic way an open innovation model that can work for Europe with ESA and the European Commission as the driving forces in cooperation with her member states.

The ESA mainly functions in a triangular relationship in together with the member states and the European commission (EC). Member states finance the ESA, and in collaboration with these three parties several goals have been set up by the EC. Their website \(^3\) states the following goals of the EC, which are set up together with the two other parties.

- **develop and exploit** space applications that serve Europe’s public policy objectives and the needs of Europe’s citizens and enterprises
- meet Europe’s space-based **security and defense** needs
- ensure Europe retains a strong and competitive space industry that is **innovative** and provides sustainable, high-quality and cost-effective service
- contribute to the knowledge-based society by investing significantly in **space-based science** and playing a strong role in international space exploration

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\(^3\) [http://ec.europa.eu/enterprise/policies/space/esp/index_en.htm](http://ec.europa.eu/enterprise/policies/space/esp/index_en.htm)
Secure Europe's unrestricted access to the best technologies, systems and capabilities to ensure the availability of independent European space applications.

1.1 Description ESPI
The European Space Policy Institute is a European think-tank in space issues located in Vienna. The mission of the European Space Policy Institute (ESPI) is to provide decision-makers with an independent view and analysis on mid- to long-term issues relevant to the use of space. Through its activities, ESPI contributes to facilitate the decision-making process, increases awareness of space technologies and applications with the user communities, opinion leaders and the public at large, and supports students and researchers in their space-related work. To fulfill these objectives, the Institute supports a network of experts and centers of excellence working with ESPI in-house analysts. This think-tank is working with all space sector stakeholders with include the European commission, the council, the European parliament, ESA, national space agencies, the industry etc.

1.2 Description ESA
The European Space Agency (ESA) was founded in 1975 as a merger from the European Space Research Organization (ESRO) and the European Launcher Development Organization (ELDO). ESRO was already working on an ESA manner, where many countries were collaborating in a group in order to do research into space. The ELDO was trying to do the same, but more fragmented, where Germany was building stage one of the launcher and France was engineering the second stage. Many of these projects failed, because the integration of these systems is very complicated. Mainly because of that reason there had to be an umbrella organization which is coordinating all different projects.

The (ESA) is a mental organization with nineteen member states (Austria, Belgium, Czech Republic, Denmark, Germany, Finland, France, Greece, Ireland, Italy, Luxemburg, Holland, Norway, Portugal, Romania, Spain, United Kingdom, Sweden and Switzerland) with has as main purpose to provide for, and to promote, for exclusively peaceful purposes, cooperation among European States in space research and technology and their space applications, with a view to their being used for scientific purposes and for operational space applications systems: They research, design, and outsource project in order to boost technology to promote and stimulate the European Economy. Their main asset is to bundle financial and intellectual streams in order to realize projects, which are for each one of member states alone impossible to achieve.

1.3 Research
The main starting point for this research was the report Key Enabling Technologies and Open Innovation. New Impulse for the Space-sector by Dr. Christina Giannopapa. This report showed that open innovation is an important concept where the European Space-sector could benefit from. Taken that report as a starting point, this study will take a look at how companies in the European Space-sector could benefit more from open innovation. The goal of this investigation is to find out if and why open innovation is an underused concept in this sector. Open innovation is a strategy which can be captured in a mental model. In order to makes this mental model clear, business models could

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http://www.espi.or.at/images/stories/dokumente/studies/espi%20report%2024%20online_1.pdf
help companies to show important key aspects of their company and how this could lead to more open innovation.

A number of companies, institutes and agencies working in the European space-sector were counseled and compared to other industries which are using open innovation for a longer period of time. The study was mainly carried out within the Dutch borders, but the international character of the ESA was taken into perspective. This means that the Dutch government and the European Commission are also involved.

This paper starts off with the problem statement, to define the actual problem and show the different research questions to be addressed. After the problem statement the literature was reviewed. The goal of this literature review was to look at the boundaries of the open innovation literature and the business model literature. Combining these two different areas of study, a synergy could be accomplished how business models could contribute to open innovation. The analysis section deals with the business model of companies and institutes that are working in the space-sector and compare these with companies that are not space related. Based on this analysis a redesign of the business model was made combined with a test report of proposed redesign. Finally a conclusion is drawn, combined with a discussion about the study and recommendation for further research.

1.4 Problem Statement
It seems like the appliance of open innovations is an underexploited area in the European space-sector, which means that the innovations done are not fully explored. At the moment many innovations are done with a specific focus on the space-sector. It might be that the innovations have other commercial applications, but it seems that these opportunities are not fully explored and exploited. If the innovation result in spins-offs, it is more or less coincidence than a preselected strategy. With the help of an open innovation business model, a certain strategy may be followed which could result in more spin-offs, and will increase the revenues from innovation in the sector. This is not solely an advantage for the commercial markets, but it may also increase the investments in innovation for the European space-sector and beyond. Furthermore with the help of jointly developing ideas and technologies with others could reduce the cost and time to market.

1.4.1 Research Questions
1. How does the current business model in the European and Dutch space-sector looks like?
2. How does the business model, focusing on open innovation, of the Dutch space-sector differs from the business model of high innovative sectors?
3. What can be done to re-innovate this current business model of companies in the Dutch space-sector?
4. How can the ESA, the EC and the Dutch government stimulate the market to get more benefits from open innovation?
1.4.2 Aim

The aim of the master project is to contribute to the development of an open innovation concept for the space-sector in Europe. For this it is needed to provide research and analysis on how innovation is approached currently in the space industries in relation to other high tech industries and how an open innovation model can be set up between different sectors for the development of KET’s. The aim is to describe the current business model of the European space-sector, and show the important characteristics of this model. A business model describes the ‘rationale of how an organization creates, delivers, and captures economic, social, or other forms of value’, according to Osterwalder (2010). Subsequently, potential changes to this business model will be inspected, within the current boundaries of the sector.
2. Methodology

2.1 Qualitative method of working

The way of working is mainly based on the handbook of Van Aken et al. (2007), which takes the regulative cycle (figure 1) as a systematic way of analyzing an organizational problem. It can be divided into three main key characteristics. The first characteristic of the cycle is that it is performance oriented, which means that it focuses on performance improvement. The second characteristic is that it is design oriented, so in this case a new design for the business model will be created. The third and final characteristic it is a theory based investigation, so that state-of-the-art scientific knowledge will be applied to tackle the problem.

The research is mainly qualitative, which has as advantage that it can use more than just the quantitative facts, but that also experiences can be taken into account, and that it has the power to look at the meaning of facts. It has even more power as it can take the specific context into account according to Van Aken et al. (2007). This is the case in the European Space-sector, because it is a one-of-a-kind industry, with a very unique context. The scientific requirements like objectivity, validity and reproducibility are grounded in the method itself. If the method is strong enough it provides sufficient intrinsic validating power to have a sound investigation.

Figure 1. Regulative cycle Van Aken et al. (2007)
2.2 Problem choice and validation

A main problem is already brought up by ESPI, but the in depth analysis should validate the problem. It happened with the help of a qualitative data collection and analysis of this data, which is in these kind of business solving problem the right strategy (Van Aken et al., 2007) The problem needs to be validated in order to target the problem in the right way, and it might differ from the problem that is in the head and minds of people (Van Aken et al., 2007). Companies in the Netherlands that are active in the space-sector were analyzed in order to find out how they experienced the current business model in the space-sector. A diagnosis was made for space companies, and also other industries will be analyzed to get a clear view of what is happening in other sectors. This is done by means of interviews. How the interviews were conducted, and captured is discussed in the interview section.

2.3 Literature review methodology

The literature search is done with the help of ABI Inform, Google Scholar and Science direct, complemented with a related article search in ABI Inform. The initial search looked for open innovation, innovation models, and business models and a combination of these words and phrases. Articles that were cited the most were inspected for their usefulness. A criterion was that the main articles were from international top quality. To check the quality of the journals the rankings at Harzing (www.harzing.com) were consulted. A second way to check the usefulness of the articles was looking at the impact factor of the scientific papers on the Web of Science. The articles which formed the guidelines for further research were from the top ten of most influential journals. Than this whole iterative process started all over again, with new search criteria and those were more focusing on business model innovation, and business model redesign. If the articles were not from international quality at the majority of the rankings they were not used. The goal was to give an overview of the current debate and combine the open innovation literature with literature focused business models, so that open business model innovation was the combination of two different literature steams. After having sketched the status quo, the two different streams of literature are combined in order to come up with one integrated framework. There are two reasons to carry out this literature analysis. First, it is important to create a toolkit to go into the field. This toolkit is filled with literary scientific concepts that can be useful during the interviews. Reading and analyzing the literature helps to get more understanding of the problem. Second, it is done to answer one of the research questions.

2.4 Data Collection

2.4.1 Interviews

The main method of data collection was conducting semi-structured interviews from key players in certain space companies, and other high tech companies in the Netherlands. The power of semi-structured interviews is that they are open, and that there is enough room for investigating the subject. If an interview is closed, there is no room for additional information, which means that important information could be missed (Van Aken et al., 2007). All the interviews were recorded, and half of the proposed fifteen interviews were transcribed. Transcription is also an extra validation step that was built in. It makes the audit trail stronger; hence you can see the actual data (Shenton, 2004). Identifiers were used, so the participants stay anonymous, but still enough information should be available (Space 1, Non-space 3). People that were interviewed can be grouped into three categories.
First, the people working within the space industry and governmental institutions like experts at TNO or the NLR. Second, business model experts from the space industry were consulted. This included space companies, but also experts working at ESA. Finally companies were questioned which are not in active in the space-sector to look at the business model from a totally different perspective. This focusses on two out three important parties that play a role in the space industry. Due to time constraints members at the European Commission were not interviewed.

Finally twenty interviews were conducted at seventeen different companies as being showed in table 1. Besides the list of companies the project type is sketched which was discussed during the interview. It is indication of the company is more active in space to space collaboration or space to non-space partnerships. Space-Non-Space indicates that a space technology is used in collaboration with a non-space partner or department. Space-space states that a collaboration was made with a technology suitable company out of the space section together with another space related company or department.

<table>
<thead>
<tr>
<th>Space</th>
<th>Relationship type</th>
<th>Relationship type</th>
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<tbody>
<tr>
<td>Airborne Composites</td>
<td>Space - Non-Space</td>
<td>Akzo Nobel</td>
</tr>
<tr>
<td>ESA Advanced concept teams</td>
<td></td>
<td>ASML</td>
</tr>
<tr>
<td>ESA Technology coordination</td>
<td>-</td>
<td>Chromalloy</td>
</tr>
<tr>
<td>ESA Technology strategy and technology research programme division systems, software and technology development</td>
<td>-</td>
<td>Oskomera</td>
</tr>
<tr>
<td>Fokker</td>
<td>Space - Space and Space - Non-Space</td>
<td>Schiphol</td>
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<tr>
<td>Heat and Surface Treatment</td>
<td>Space - Non-Space</td>
<td>Shell</td>
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<td>Lionix</td>
<td>Space - Space</td>
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<td>Microflown Technologies</td>
<td>Space - Space</td>
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<tr>
<td>Nederlands Lucht en Ruimtevaart Laboratorium (NLR)</td>
<td>Space - Space</td>
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<tr>
<td>Satrax</td>
<td>Space - Non-Space</td>
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<td>Space Expedition Curacao</td>
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<td>SRON Netherlands Institute for Space Research</td>
<td>Space - Space</td>
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<tr>
<td>Technovia</td>
<td>Space - Space and Space - Non-Space</td>
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<tr>
<td>TNO</td>
<td>Space - Space and Space - Non-Space</td>
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Table 1. Interviewed companies
2.4.2 Other data
Besides the interviews, more data was collected in the data collection phase. Most of the data collected are reports and presentations from space companies and agencies. The idea for this research was born based on the report by Dr. Giannopapa named ‘Key Enabling Technologies and Open Innovation. New impulse for the space-sector. (2010)’. This was an interesting starting point. For the sector overview annual reports with sector data were used, like the ASD Eurospace report, facts and figures (2011) and Euro consult report European space-sector dated from 1997. Furthermore annual reports of the ESA and the ESPI were used, complemented by the ESA newcomer’s presentation by Eike Kircher (2009). Finally a report of the Dutch government is used named ‘Nederland en Ruimtevaart’ with reference number 080137 dated from 2008.

2.5 Data Analysis
The data analysis consists out of scientifically dealing with the collected interviews. The first eight interviews conducted were transcribed, and the other half of the interviews was summarized. All conducted interviews were coded. Interviews were placed into two categories, namely space-sector and non-space-sector. An analysis was made between these two groups. All different aspects of a business model were looked at, combined with a broader view between all aspects of the business model. Looking the external environment, six different external aspects (Political, Economic, Social, Technological, Legal, and Environmental) were analyzed individually and finally a more in depth analysis was carried out between these factors. As last past of the analysis the measurement of innovation was an area of interest. This was done to show differences between measuring innovation in space and non-space sectors.

The analysis mainly was done by means of coding, with the help of NVivo. “Coding is a systematic way in which to condense extensive data sets into smaller analyzable units through the creation of categories and concepts derived from the data” (Lockyer, 2004, 2). NVivo was the program that was used for this. NVivo is a tool to code qualitative data, to make it more objective and better grounded. The grounded theory approach was used to structure the qualitative way of working. According to Van Aken et al. (2007) three main ways of coding could be used, namely open coding, theoretical coding, and selective coding. This subdivision is also made by Strauss & Corbin (1990), which describe open coding as the categorization of the data. The theoretical coding is the coding that makes connections between categories after open coding, and the selective coding, selects the core category, makes relationships between the categories and tries to give logical explanations between those relationships. The ‘category system’ should be carried out in all interviews to make a logical category structure into the data according to Strauss & Corbin (1990).

This study made use of selective coding; hence this makes the coding process easier, because you have some categories to order your data before you start coding. The coding scheme is located in Appendix II. Some open coding was used too, because new interesting concepts popped up during the analysis. After the data was structured, the data was inspected for commonalities and interesting aspects. This was done for every individual aspect of the business model and for the whole business model in order to find if extraordinary aspects were present in the data. It was structured in tables to make the objectivity better, and finally analyzed and written down.
3. Theoretical review

3.1 Open innovation in space

3.1.1 Open innovation

Innovation in the space-sector is one of the most important drivers for success. This study will cope with how this innovative power can be enlarged in the European space-sector. Nowadays innovation is important in the business economy. Studies have shown that if companies do not continuously innovate, their chance of survival and success will decrease (Tushman, 2002; Amabile et al. 1996; Mumford et al. 2002). Burleson (2005) states that there is consensus in the literature that innovation deals with a “process” that results in a “novel” and “useful product.” The Netherlands used to be a trading and producing country, but during the years a shift has taken place, and companies have been focusing more on knowledge and innovation. The knowledge economy is a term from the economy, which usually means that a significantly important part of the economic growth is due to (technological) knowledge. Former agricultural and manufacturing industries are nowadays changing towards the knowledge and services.

This study looks at a specific part of innovation, namely open innovation. Chesbrough found in 2002, after having studied several companies, that industrial R&D was dealing with a paradigm shift from a close to an open innovation model. Scientifically open innovation is defined as ‘firms that can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology’ (Chesbrough, 2003, pg 24). The definition is further clarified in 2006, (pg 1), where Chesbrough states “open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively”. Chesbrough’s definition of openness is the most frequently used definition in literature. It is a broad definition and it stresses on the fact that valuable ideas emerge and can be commercialized from inside or outside the firm. The latter part is really important, because the open innovation process tries to combine internal and external ideas to create new products of systems. This study combines open innovation with business models, to create scientific synergy. First, the concept of business models will be discussed. Next, based on a specific model by Osterwalder et al. (2004), all individual concept of that specific business model will be explained and linked with open innovation literature.

3.1.2 Open innovation in space

This upcoming section gives a short introduction about literature that is written about open innovation in space settings. The major literature is published in several journals like Space policy, Space research today and Space science reviews. Most of the articles are related to space content related issues instead of organizing the space industry. Keywords as open innovation are not frequently found and did not provide a lot of interesting findings. This could indicate that the space sector is more focusing on the technologies applicable for space instead of building a policy or an innovation network around it. Peeters (2002) confirmed this sketch by stating that space was mainly focusing on the technologies. He furthermore states that space activities are changing from government funded projects towards commercial undertakings. ‘In 2000, the 50% mark was reached in Europe and this figure shows a steadily increasing tendency’ (Peeters, 2002, pg 1). According to this author the next step to be made is to make use of strategic. Some scholar mentioned several years ago that innovation and competitive innovation is vital for a sustainable growth of the space...
industry (Hansson, 1997). Others go more in depth about specific aspects of open innovation like IP. Balsano published, in 1995, an often cited article which goes into depth about IP rights and how these IP rights affect and influence innovations in space. Concluding you can state that not much research is done on open innovation of space, and how to arrange this open innovation.

3.2 Business models

First, the concept of business model has to be defined properly. Two scientific definitions are given below, to get a more in depth understanding of the context. ‘A business model is the bundle of specific activities that are conducted to satisfy the perceived needs of the market, along with the specification of the parties that conduct these activities (i.e., the focal firm and/or its partners), and how these activities are linked to each other’ (Amit and Zott, 2010, pg 5). ‘The business model provides a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic outputs’ (Chesbrough and Roosenbloom, 2002, pg 4). The two different definitions both are touching essential aspects of a business model. They show that a business model is a mediator between the technology, resources and other inputs on the one hand and economic value creation on the other. It is a sequence of steps that have to be taken from a technology to become an innovation, and then towards the market where it should result into economic value. This process of adding value can be captured in a business model. This study focuses on open innovation, so the literature was consulted for a combined definition of open innovation and business model. This is a specific type of business model, as it needs to combine internal and external ideas as seen earlier in this literature review. Chesbrough et al. (2006) came up with a widely used definition; ‘The open innovation business model utilizes both external and internal ideas to create value, while defining internal mechanisms to claim some proportion of that value’. A more general definition is given by Lichtenthaler. He states that the role of the business model in capturing value enables a firm to profit from open innovation’ (Lichtenthaler, 2011, 3). The business model concept that is used is the one from Osterwalder et al. (2010), which is shown in figure 2.

![Figure 2. Osterwalder et al. (2010) Nine point decomposition of a business model](http://bussiness-model-design.blogspot.com/2005/11/what-is-bussiness-model.html)
3.2.1 Value proposition

‘A value proposition is an overall view of a company's bundle of products and services that are of value to the customer’ (Osterwalder, 2004, pg 43). In the literature three main types of value propositions are distinguished. The first one is operational excellence, which is ‘providing customers with reliable products or services at competitive prices and delivered with minimal difficulty or inconvenience’ (Tallon, 2008). Second, customer intimacy relates to ‘segmenting and targeting markets precisely and then tailoring offerings to match exactly the demands of those niches’ (Tallon, 2008). And the third one is product leadership and according to Tallon (2008) this means focusing on the products and services and continuously improving these products/services, to make the best for the customer. Chesbrough (2006) stated that if companies focus on technology and solely improving the quality of their products this is disastrous for open innovation. This implicates that product leadership is not the right strategy for achieving open innovation. As Tallon (2008) describes, companies possess different values in order to maximize their added value to the product of service. The definition of open innovation implies that the revenue is generated by a firm cooperating with another one, so companies should look for complementary values in order the create synergies. Van Burg et al. (Working paper 2012) identified three different types of value a company could create and appropriate, namely reputation value, commercial value, and technological value. On the one hand the complementarity can be found in the different use of the same value. And on the other synergetic effects can be found if different companies appropriate different values.

3.2.2 Target customer

‘The target customer is a segment of customers a company wants to offer value to’ (Osterwalder, 2004, pg 43). A market segment is a part of a market, where the target customers have one or more similar characteristics. It has characteristics to make the market identifiable, so that a company can target and respond to similar groups of customers. The market segment has to be identifiable, sustainable, accessible, stable, responsive, and actionable, to be able to target it on the right manner (Wedel et al., 2000). Literature analysis did not show any indications of open innovation as an outcome of specific targeting of customers. Literature shows that companies that plan to work together might be partners and competitors at the same time. Bengtsson and Kock (2000) named this phenomenon coopetition. This might be a potential risk of open innovation, because ‘competitors within an alliance can resist from acting in conflict with each other to get the alliance to work’ Bengtsson and Kock (2000, pg 2). It seems plausible that different companies focus on the same target customer in order to achieve something together. What may appear is that companies compete in the same market, which can hamper the cooperation within the alliance.

3.2.3 Distribution channel

‘A distribution channel is a means of getting in touch with the customer’ (Osterwalder, 2004, pg 43). Distribution is an important part of the management of supply chains. It might be that shared distribution channels could lead to synergic advantages, and it can lead to the first steps of open innovation. Two main types of distribution channels have been described in the scientific literature. The first type is direct distribution, which means the direct delivery from the product to the end customer. An example is selling via internet, or insurance policies. The other type is called indirect distribution, which means that there is another company between the company and the end user. Examples are wholesales companies and retail companies.
Another important distinction is made in the literature. A ‘key factor is the strategic trade-off between establishing a novel value chain and competing against incumbent firms versus leveraging an existing value chain and collaborating with incumbents (Gilsing et al., 2010, pg 17). This study also states that in business where IP protection is granted, it is better to work together with several distribution channels to avoid sunk costs. This study shows that companies only should make use of the same distribution channel if the IP protection is forthcoming. Otherwise cooperation might turn into competition and there might be a chance of losing customers.

Finally there is one type of distribution channel that fits very well for open innovation, while this type of distribution channel causes a dependency relation on its self. A value-added reseller (VAR) is a company that adds value, by means of features or other improved aspects on the products or service, and then distributes it to the end customer (Chesbrough, 2006). This research shows that this type of distribution channel is good for achieving more open innovation, because the distribution channel implicates a type of cooperation. The VAR needs to get detailed information about the product in order to efficiently add value to the product.

3.2.4 Customer relationship

‘The customer relationship describes the kind of link a company establishes between itself and the customer’ (Osterwalder, 2004, pg 43). Companies that want to work together should have the same customers, in order to create the best synergetic advantage. An example to build up a customer relation is by the means of using customer relationship management software (CRM). Using the same the same software tools (e.g., CRM software), could lead to more open innovation (Chesbrough, 2006). There is also a drawback of open innovation as mentioned earlier in this thesis. Bengtsson and Kock (2000) stressed on the fact that if companies have the same customer base, and when they are collaboration and competing on the same market, this coopetition might cause companies to lose customers. Open innovation can foster relationships with new customers, but it can also cause the companies to loose these relationships.

3.2.5 Key activities

‘A key activity or core capability is the ability to execute a repeatable pattern of actions that is necessary in order to create value for the customer’ (Osterwalder, 2004, pg 43). Lichtenthaler (2011) states that there are three main activities linked to open innovation which can be organized internally or externally. These activities are integrating inward and outward knowledge transfer, simultaneous internal and external organization of critical knowledge-management processes, and finally linking technology management to open innovation. This paper states that there are three main phases where an open innovation project could be in. Knowledge exploration is the first step where investigation takes place which knowledge could be used for which purpose. The second phase is knowledge retention where the knowledge protection should be granted. It might happen that the knowledge is spilled. Finally the last phase is the knowledge exploration. This focuses on how to get revenue out of the knowledge. The body of the paper by Lichtenthaler (2011) mainly deals with the technology transactions, as being one of the key activities that companies have to comply to, if they want to achieve open innovation. This mainly involves selling and buying knowledge from or towards companies. Lichtenthaler (2011) investigated different organizational capacities. On the project level, the decision making was looked at, and at the individual level, personal attitudes were discussed. Finally, Chesbrough (2006) states that focusing the key activities too much on technology development activities solely, is fateful for open innovation.
3.2.6 Key resources

Dahlander and Gann (2010) have looked at the balance between internal and external resources to create open innovation. As stated earlier, the concept of open innovation is based on the collaboration of two companies. This collaboration and competition discussion, called coopetition, might, resource-wise, be a potential risk. To minimize the drawbacks of this phenomenon, there must be heterogeneity of the resources according to Bengtsson and Kock (2000). If there is not a good balance between the internal and external resources, the resources might act as a substitute innovation source instead of a complementary resource.

A resource that frequently has been discussed is open source software. ‘The open source approach is the phenomenon of co-operative software development by independent software programmers who, on demand, develop lines of codes to add to the initial source code to increase a program’s applicability, or enable new applications’ (Gassman et al., 2005). This study states that open source is one of the most revolutionizing examples of the paradigm change from closed towards open innovation. The main vision behind the open source software is that it is, after, creation available outside the firm boundaries. Companies could work together with this software in order to innovate together. It causes the knowledge flow from inside the company to go outside, to create opportunities for co-operative innovation (Gassman et al., 2005). A second advantage brought up by West and Gallagher (2006) is that investments for the open source software could be shared with potential competitors that could be partners with the help of this software tool. Although open source software is one of the main resources of adding value, companies do have to be careful, because it could lead to ignorance of other important resources (Chesbrough et al., 2006).

3.2.7 Partnership

A partnership is a voluntarily initiated cooperative agreement between two or more companies in order to create value for the customer (Osterwalder, 2004, pg 43). Dahlander and Gann (2010) investigated the recent literature about open innovation and looked at how open firms are, and what the main boundaries to openness are. They define openness as ‘various relationships with external actors’ and this is ‘closely coupled to a broader debate about the boundaries of the firm’ (Dahlander & Gann, 2010, pg 2). This study states that the forms and number of relations with external parties are important for the openness of the firm. Social networks in companies play a central role in knowledge creation and research in development (Powell, 1990; Burt, 1992). There is no consensus in the literature how to create the best network in order to have the highest risk of success in open innovation activities.

First, an influential piece of research is from Granovetter (1973). He investigated a person’s social network and how this influenced this specific person in getting a job. His most important conclusion was that if a person has a lot of weak ties in his/her social network it was considered as strength. The persons with this specific network characteristic were found to be at higher risk of finding a job. This concept, also called the strength of weak ties, state that having a lot of weak ties in your network facilitates a brokerage position. A person can act as a broker, as he can function as bridge between different cliques. Brokerage is an important characteristic in open innovation, because a broker could be the missing link between two parties in order to create synergic effects between two or more companies.

Second, there is a stream of literature that focuses on the advantages of close networks. There are two main strengths of closed network according to Coleman (1988). On the one hand a trustworthy environment. A trustworthy environment ensures the safety of the information. The second strength
is that close networks are rich of people that have the same shared norms of behaviour. Both of these arguments are important for innovation, because information sharing leads to more open innovation (Chesbrough, 2006).

Third, Burt’s network study (1992) introduces structural holes, a new concept regarding alliances and open innovation. These so called structural holes are ‘relationships of non-redundancy between two contacts’ (Burt, 1992, pg 2). Holes can function as buffers in such a way that these buffers between the contacts provide network benefits which are in some degree additive rather than overlapping according to Burt (1992). In conclusion structural holes are a few strong ties with others, which have others that you do not know that well. This network would, according to Burt (1992), lead to an information-rich network, which can lead to more open innovation.

3.2.8 Cost structure

‘The cost structure is the representation in money of all the means employed in the business model’ (Osterwalder, 2004, pg 43). In other words, it’s the expenses of firms that you have to take into account when producing a good or providing a service. Advantages for open innovation can be gained by sharing the research and development cost, according to Chesbrough (2006). This leads to the same focus area, and to shared behavior which is stated as important for innovation by Coleman (1988). Furthermore, there is no specific type of cost structure found that showed evidence of being important for open innovation.

3.2.9 Revenue model

‘The revenue model describes the way a company makes money through a variety of revenue flows’ (Osterwalder, 2004, pg 43). Intellectual property (IP) plays an important role in open innovation business models, according to Chesbrough (2006). The way to generate revenue from knowledge or IP is by means of patenting. ‘A patent is a legal title granting its holder the exclusive right to make use of an intervention for a limited area and time by stopping others from, among other things, making using or selling it without authorization’ (Grandstrand, 2000, pg 71). When a company grants the authorization with a patent to another company, by the means of licenses, the company with the patent could create revenue by means of a license. Grandstrand states that ‘licensing is the entitled use of the patent, by paying a fee to the licensor’ (Grandstrand, 2000, pg 75). This can foster the collaboration between a party which possesses knowhow, and another party for whom the information is valuable. Open innovation can be stimulated if a party with the knowhow uses licenses so that another company can use that knowledge. A question might arise, why these companies can’t commercialize this technology themselves. It might be possible that a company is specialized in the technology, while the other company is good at the production of goods. Licenses create the opportunity to help companies with the knowhow, generating revenue through their IP.

3.3 Business model innovation

A radical way to change the business model is through a concept which is scientifically described as business model innovation. This process of business model innovation is vitally important, and yet very difficult to achieve, according to Chesbrough (2010), and a way to outperform competition and provide more innovative output looking at a study done by Mitchell and Coles (2003). The concept needs to be defined in a uniform way. ‘Business model innovation is a continuous process which involves designing a modified or new activity system, and it relies on recombining the existing resources of a firm and its partners, and it does not require significant investments in R&D’ (Amit and
Zott, 2010, pg 2). These scholars suggest that it is a continuous process to develop a business model. This last part touches the concept of open innovation; as it makes use of resources of other companies.

According to Amit and Zott (2010) there are three main reasons for business model innovation. Firstly, they state that it is an underutilized source of future value for business. Secondly, it is harder for competitors to replicate an entire novel system. Finally it can be used to get a bond with suppliers to work together. Chesbrough (2010) identified two main company factors that are essential for business model innovation, namely good leadership and the perseverance for a possible culture change. Furthermore, Chesbrough (2010) states that companies must adopt an effectual attitude toward business model experimentation to innovate the business models. This concept, called effectuation, is brought up by Sarasvathy (2001). Effectuation is based on the principle that you perform a certain action, and that you respond to the outcome of that action, by the means of a new action. The philosophy behind it is that the future cannot be controlled, as in the conventional causation process, which is based on reasoning from causes to effects.

### 3.4 R&D Collaborations

An important aspect of innovation is making use of collaboration in order to carry out innovation together in an alliance of joint venture. The way of organizing such a partnering structure could vary greatly. There could be intentional agreements which are very informal. A strategic alliance goes one step further and states that there are business owners or companies which have as common goal to implement a common strategy. Finally, you have the most formal form which is name joint venture, which usually is set up for a specific project. Nurala (1999) describe an increase in growth in these strategic R&D alliances. The main reason she describes is that globalization made the world smaller and provided more opportunities for companies to look outside their border. This reason is backed up by evidence from Chesbrough (2003). Furthermore, companies are looking across their own borders in order so seek for new opportunities instead of achieving situations for control. This changed led the past decade toward more alliances and collaborations in the industry. Chesbrough (2006) stated that open innovation is useful if there is an abundance of knowledge, and Golman et al. (2009) stated that R&D collaborations could also be used to exploit this diffusion of knowledge. Sampson (2011), who did extensive research in R&D alliances, stated that ‘alliances contribute far more to firm innovations when technological diversity is moderate’. This could implicate that it is easier to do innovations with partners in your own market, than across different markets. Furthermore, she states that partners need to have different incentives to share information in order to make the alliance successful. R&D alliances could play a role in facilitating more open innovation initiatives in the market, but need to be set up in a careful manner in order to maximize the full potential of this collaboration form.

### 3.5 Design principles for open innovation

The upcoming section will take a look at open innovation and will deduce design principles for open innovation. Besides the in section 3.4 discussed R&D collaborations this section makes another difference between types of open innovation. Firstly inbound open innovation will be described and secondly outbound open innovation is an area of interest that will be discussed.
According to Golman et al. (2009) a company that is active in inbound open innovation sources knowledge from the outside world. Important aspects of inbound open innovation are the appropriation of external knowledge and the integration of this knowledge. Lichtenthaler et al. (2010) describe outbound open innovation as ‘an inside-out process and includes opening up the innovation process to knowledge exploitation.’ External knowledge exploitation means to commercialize the knowledge you possess to the outside world seen from out the company’s perspective. Outbound open innovation has been relatively neglected during the past decade (Chesbrough, 2003; Lord, Mandel, & Wager, 2002). A particularly important limitation seems to be ‘an insufficient theoretical foundation along with an insufficient consideration of earlier work into related fields, such as user innovation and absorptive capacity’ (Lichtenthaler et al. 2010). After a short introduction about the methodology, three design principles about inbound and outbound open innovation will be given.

Design principles regarding outbound innovation were set up according to the CIMO logic. This acronym (CIMO) represents a combination of a problematic Context, for which the design proposition suggests a certain Intervention type, to produce, through specified generative Mechanisms, the intended Outcomes (Denyer et al. 2008). These principles contain situation descriptions that were taken from the context of the space-sector, combined with a proposed solution based on the literature and the conducted interviews. According the literature, an explanation is provided why this proposed solution mechanism works. And why it leads to a desired outcome.

An example is: In a complex R&D environment (C), the use of wikis (I) lessens hierarchies, and makes the (tacit) knowledge easy accessible (M), which increases the exchange of knowledge from diverse sources, and will increase the meta-knowledge among the employees (O).

### 3.5.1 Licensing

In articles of Chesbrough (2003, 2006), he states that firms can make use of licenses in order to put their developed ideas into the commercial market. He calls this phenomenon commercializing inventions. This statement is also backed up by other scholars. ‘By selling or out-licensing, firms can more leverage out of their investments in R&D, partnering with actors adept at bringing inventions to the market place’ (Dahlander & Gann 2010, 8). Another study by Gassmann and Enkel (2006) state that firms should use and exploit their internal knowledge and inventions on the market place. One of the best ways to do this is to license out inventions and technologies. In order the reach the full leverage of investments in R&D and to create more outbound open innovation firms should license out their technology to partners so they can simultaneously benefit from the inventions and make it commercial on the market place. Many benefits of licensing are known nowadays, but it lacks vision and strategic planning in order to make licensing beneficial for companies.

If you relate this knowledge to outbound open innovation you see that licensing provides opportunities for companies to further extend their potential of the innovation. Grindley & Teece (1997) state that one of the best ways, to get access to external knowledge, is to use cross license agreements. Besides the financial advantages, it has also legal benefits. Many technological firms see difficulties in open innovation regarding the disclosure and secretly among their technologies. Dahlander and Gann (2010) stressed on the fact that there is a paradox in outbound open innovation. They state that in open innovation’ firms attempt to be open yet are able to appropriate commercial returns from their innovative effort’. This paradox can be solved by means of formal
license agreements. This dissolves the negative sides of open innovation, looking at the fact that traditional companies are very protective regarding their technology.

In a highly technological/R&D driven environment (C), companies should make use of (cross) licensing agreements(I), so that knowledge will be more accessible in and outside the sector(M), to get more outbound open innovation(O).

3.5.2 Open source software
The open source approach is the phenomenon of ‘co-operative software development by independent software programmers who, on demand, develop lines of codes to add to the initial source code to increase a program’s applicability, or enable new applications’ (Gassman et al., 2005). The main vision behind the open source software is that technologies after creation are available outside the firm boundaries. It causes the internal knowledge flow to get more widely available, even across the borders of the initial company. This creates opportunities for co-operative innovation (Gassman et al., 2005). A second advantage, brought up by West and Gallagher (2006), is that investments for the open source software could be shared with potential competitors that could be partners with the help of this software tool. ‘If firms rely on open-source approaches to develop products that are then commercialized internally or externally, they follow an open innovation approach because the business model enables them to capture value from open innovation’ (West & Gallagher, 2006). Concluding you can state that there are two main advantages of open source software that foster outbound open innovation. Firstly the fact that co-developing open innovation software, leads to a collaborative environment where innovations can be shared. Secondly is that technologies after creation are available outside the firm boundaries which makes it a very good tool for outbound open innovation.

In a highly technological/R&D driven environment (C), companies should make use of co-developing an open source software platform (I), so that knowledge will be shared during the development of the tools, and the knowledge is available outside the firms boundaries(M), to get more outbound open innovation (O).

3.5.3 Absorptive capacities
In order to let the first two initiatives work companies should also be active in inbound open innovation. This final subtopic deals with the capacities that a company should possess to capture the knowledge which is around in the market. Absorptive capacities are capacities that filter important knowledge out of the market and make them useful in the company. A more formal definition of absorptive capacity is to internalize external knowledge. The founders of this concept Cohen and Levinthal (1990) define it as ‘the ability to recognize the value of new information, assimilate it, and apply it to commercial end’. Examples of these capacities are knowledge management, human resources, external interactions, supplier integration, and customer relationships management. Because of the fact that the learning effects of absorptive capacities are cumulative, the effort you put into the building of these capacities will make it easier in the future. Cohen and Levinthal’s (1990) suggest that a company should create ‘absorptive capacity to track and evaluate developments outside firm boundaries.’ Concluding you can state that absorptive capacities are a must-have for a company to be active in outbound innovation, because you should possess
different capabilities to capture knowledge from the outside world. If you know how to capture this knowledge, it is also easier to be active in outbound innovation.

In a highly technological/R&D driven environment (C), companies should develop absorptive capacities(I), so that the company knows how to access and distribute knowledge from and towards the outside world (M), so they will get more outbound open innovation (O).
4. Analysis

The analysis consists of two main parts. Firstly a sector description of the space industry is given, which includes the European and the Dutch space-sector. The European sector description deals with features of this sector and takes a closer look at the ESA. The Dutch analysis consists of features of the sector and Dutch subsidies. This is mainly based on interviews and sector relevant data. The second part is an analysis based on interviews. This section consist out of three main parts, including an internal analysis of the business models of the companies, an external analysis dealing with factors that cannot be affected by the company itself, and finally an analysis about how innovation is measured in and outside the space-sector.

4.1 European sector description

The European Space Agency, who’s goal it is to have a co-operative approach, connects fifteen European States for developing space technologies. All of these systems and technologies are used for peaceful goals. Research from 1997 (Euroconsult report) showed that around thirty thousand people are working in the European space-sector. In 2010 this figure reached the thirty five thousand employees according to the ASD Eurospace report, facts and figures 2011. The total turnover in this sector reached over six billion Euro in 2010.

The financial model that is being used is based on a georeturn system, which shortly means that a country pays a specific amount of money to the ESA, and the ESA on her term distributes this money back via commercial tenders. The sector roughly acquires three and a half billion Euro of a yearly basis (report ESA and the EU, October 9, 2008), which they distribute back to companies in the member states. According to Annex 1 from The European Space-sector in the World by Wiseman 2.6 billion Euros is reserved for space applications and activities. From this 2.6 billion, 1 billion Euro is for the Galileo satellite navigation programme. Mainly there are three large system integrators namely, Astrium, Thales and OHB, which are taking the responsibility for most of the large space project in the European Union. The ASD Eurospace report, facts and figures 2011 showed that these three companies take over sixty percent of the turnover for their account.

According to the ESA Budget presentation from 2011, there are seven important pillars where the European space-sector consists of, completed by some smaller areas of interest. This is verified by the ASD Eurospace report, facts and figures 2011.

**Space Science & Exploration:** Space science is based on mainly astronomy and a further exploration of the existence of the Solar system,

**Navigation:** The most important project is the Galileo, which will be the first commercial, nonmilitary, navigation system ever build.

**Telecommunications and integrated applications:** This is the main commercial activity in the European space-sector. Commercial money flows into this pillar, but public money still is invested into this system.

**The IAP and SATCOM-APPS:** ‘These programmes are dedicated to the evolution of customized solutions and the establishment of innovative services based on feasibility and demonstration projects as well as awareness activities.’

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4 http://iap.esa.int/
**Earth Observation:** Instruments from the space are nowadays vital for predicting the weather, and monitoring/predicting the nature. Interviews showed that this has commercial potential, but is not fully exploited yet. One of the main projects is the GMES, which stands for Global Monitoring for Environment and Security.

**Launchers:** During the space race in the cold war, every major industry in the world wanted to have their own launchers. Ariana was the launchers programme of Europe, which resulted in to a first launch on December 24 in 1979, and has had five successful versions.

**Manned Space:** Manned space is mainly a collaboration between all space agencies in the world; hence the International Space Station (ISS) is developed by all important agencies in the world.

### 4.2 ESA way of working

This section is devoted to go into more depth of how the ESA is exactly working. The reason why the section is dedicated to the ESA is because of the fact that interviews showed that almost all business in the Dutch space-sector is done in collaboration or for the ESA. Only two space companies interviewed told that they were not working with the ESA. This validates the dedication of this paragraph to the working method of the ESA. The European member countries pay yearly a certain amount of their Gross National Product (GNP), towards the ESA. ESA collects this money and set out certain Invitations to Tender (ITT). Eighty percent of the money that comes in is set out as tenders for commercial companies, which are free for every member state to tender on. After the tendering period the ESA decides which the most suitable partner to work with is. The other twenty percent is used for doing in house research and testing the solutions which companies have made. Tenders are available on the EMITS website, which stands for ESA invitations to tender system. Companies should look on this website if they possess the expertise to successfully complete such a project. Interviews showed that it is usually not possible to do these kinds of projects alone, so consortiums and partnerships should be formed in order to get the tender. The process is schematically represented in figure 3 and the data that is being used is data that is collected at the second interview at ESA, at the technology strategy and technology research programme division systems, software and technology development.

![Figure 3. Schematical representation of the ESA's working method.](image-url)
An example of an ITT description from the EMITS site is shown below:

'The subject of the proposed Invitation to Tender (ITT) is the provision of support and turn-key projects for ESA's ITI Evolution and Innovation, including the following: Workplace (desktops, laptops, printing, back-up, messaging and collaboration), Communications (data, voice and video networks, mobility, telephony, videoconferencing), Security; Private Cloud (i.e. the virtualized infrastructure: hosting, storage and computing on-demand). ESA will select few contractors to take care of Study and evaluation activities, Project Management, Engineering, Prototyping and piloting, Testing and validation, Packaging of services for integration into ESA IT Service Catalogue, Service migration tasks. '

A lot of information is provided in the tender document. Examples are the exact specs of the project are present in the document, but also the milestones and the states in which the project should be to get extra funding. In some project ESA states that it is obliged to work with partners, which is done to stimulate the collaboration between different disciplines.

4.2.1 Technology Readiness Level

Interviews at Dutch space companies showed that TRL levels were often used to classify their technology and were dependent if they could do projects with ESA. This model is made to classify technology and is adapted from a model NASA used to qualify their technology. The main goal of the TRL is to see which technology should be used for what project. The model is shown in figure 4 and reaches from level 1 until level 9. If you are at TRL level 1 there is just an idea. In level 4 a laboratory experiments has been taken place to show that the technology is working in a laboratory. And in level 9 a successful operation has been carried out already. Interviews at ESA showed that most of the tenders are looking for technology from level 6 until level 9. This implicates that the ESA wants to work with proven technology instead of investing in new radical innovations.

9) Actual system “flight proven” through successful mission operations
8) Actual system completed and “flight qualified” through test and demonstration (Ground or Flight)
7) System prototype demonstration in a space environment
6) System/subsystem model or prototype demonstration in a relevant environment (Ground or Space)
5) Component and/or breadboard validation in relevant environment
4) Component and/or breadboard validation in laboratory environment
3) Analytical and experimental critical function and/or characteristic proof-of-concept
2) Technology concept and/or application formulated
1) Basic principles observed and reported

Figure 4. TRL levels (adapted from ESA newcomer’s presentation by Eike Kircher) (2009)
4.2.2 ESA open innovation initiatives
The upcoming section will describe three of ESA’s initiatives to enhance open innovation in the space market.

4.2.2.1 Innovation triangle initiative
Looking at the fact how ESA deals with innovation and open innovation in particularly three examples were found. The first one is the ESA Innovation Triangle Initiative (ITI) as can be seen in figure 5. The goal of this initiative is to bring three important stakeholders together, which as goal to enhance and catalyze the introduction of radical innovation in the European space-sector. The goal it to combine the creativity from research centers, together with the developing capabilities of companies to finalize a specific end project for the customer. When aiming to bring these three entities together the innovation should be adapted earlier and more open innovation should happen in the market. This initiative could be used either to foster space to space innovations and space to non-space collaborations.

![Innovation Triangle Initiative Diagram]

Three types of activities aimed at the different elements of the triangle:
(A) Proof of Concept (for INVENTORS): fast validation of new ideas
(B) Demonstration of Feasibility and Use (for DEVELOPERS): component and/or breadboard development up to validation in the laboratory
(C) Technology Adoption (for CUSTOMERS): development up to validation in a relevant environment.

Figure 5. Innovation triangle (adapted from ESA newcomer’s presentation by Eike Kircher) (2009)

4.2.2.2 Network partnering initiative
The second initiative is called the ESA’s Networking/Partnering Initiative (NPI) supports. This initiative is operationalized by research institutes like universities or other knowledge centers. The main goal is to increase interaction between ESA, European universities, research institutes and industry according to website of the ESA. This initiative focused on potential spin-ins and spin-outs from the non-space sector. Examples are consumer electronics, Nano technology markets and even micro technology sectors are consulted for useful information. The philosophy behind the NPI is intensifying interaction with universities in order to strengthen links with space institutions and industries. They try to encourage these institutes to contribute the long-term needs of Europe’s space programme. This is done with the help of co-funding up to 50- percent of the project. By accessing the ESEC facilities and providing them with technical support. And finally the NPI helps to search for industrial partners for further cooperation.

4.2.2.2 Technology transfer programme
The third and a final initiative is called the Technology Transfer Programme (TTP). The main working way is to share benefits of doing R&D research with ESA. This is mainly an initiative that fosters technology transfers from space to non-space industries, while the technologies are made available to the rest of the European industry.
The ESA tries to identify industrial needs and tries to fit them to suitable space technologies, which enables companies to use space technologies for a total different purpose. According to the website of the ESA the TTP also tries to support new business with the implementation of these technologies. This implementation process focuses on operations and business development. The start-ups are provided with a network of support sources, and even initial funding is provided.

An office is set up named the Technology Transfer Programme Office (TTPO). This office has the responsibility for all initiatives in order to foster the technology transfers. This can be done via various initiatives, namely technology brokers, national TT initiatives, an online forum, and other initiatives. This office coordinates four incubations centers in Noordwijk, Darmstadt, Rome and Oberpfaffenhofen.

4.3 Dutch sector analysis

The Dutch sector analysis deals with two important aspects. Firstly the Dutch market is described and secondly important and space relevant Dutch subsidies are dealt with.

4.3.1 Dutch Market

The Dutch market brings up around 130 million Euros (figure 6) on a yearly basis based on a report of the ministry of economic affairs, 080137, published in 2008. Space in the Netherlands continues to profit from expected growth. In the past the focus was exploring the unknown and more of a prestige battle with manned space flight and working with microgravity. Following the vision of Brussels, key enabling technologies are now coming out of the space, which are boosting the Dutch economic climate according to the ministry of economic affairs.

Figure 6. Yearly turnover in the Dutch space-sector (080137, ministry of economic affairs) Source: Nederland en Ruimtevaart 2008

Around thirty companies are currently working in the Dutch space-sector according to the industry association, of which half of these companies are interviewed. If you should look at companies that are solely working in space than this number can be counted on just one or maybe two hands. These figures are taken from the report of the ministry of economic affairs, 080137, published in 2008.

Approximately thousand people are working in the Dutch Space-sector as can be seen in figure 7. The largest company in the Netherlands is Dutch Space, taken more than half of the ESA projects as main supplier.

Figure 7. Employees in the Dutch space-sector (080137, ministry of economic affairs) Source: Nederland en Ruimtevaart 2008

Two companies are fully commercial working in the Dutch space-sector, namely ISIS (Innovative Solutions In Space) and Space Expedition Curacao. Fully commercial means that no ESA funding is flowing to these companies. ISIS is a spin off from the Delft University of Technology, and this company is building Nano satellites. They try to sell low budget satellites, even via a web shop on
their website. Space Expedition Curacao is trying to be the first company that is facilitating tourists to go into space. Five main knowledge centers are working in the Dutch space-sector. Delft University of Technology is the first one, which even has a faculty dedicated to space research. The second knowledge center is the NLR, the Dutch (Aero) space laboratory. They are mainly specialized on testing, and have a state of the art testing facility in Marknesse. TNO space is the third research center which has optical imaging as their specialty. The fourth research center is SRON, which stands for space research organization Netherlands. It is the national center for the research and development of satellites and more specifically satellite instruments in astrophysics. Finally the NSO, the Dutch space office which is a knowledge center that is broadly scientifically is trying to explore the space. Most of the projects are coordinated by ESA, while the Netherlands has no space agency.

### 4.3.2 Dutch Subsidies
Two main subsidy initiatives are important for the Dutch Space-sector as interviews have showed. Firstly the PEP subsidy and secondly the WBSO is used often in the market.

#### 4.3.2.1 PEP
The main goal of the PEP, which stands for prequalification ESA programme rule, is to strengthen the position of Dutch space institutes and companies for getting space tenders from the ESA in the international context. PEP is available for the Dutch industry, knowledge institutes and universities that are working in the space-sector. Seventy percent of the project is subsidized with a maximum of € 350 000 per project. Around four million euro is available every year. The rules of the PEP focus on bringing companies together and are trying to enforce close collaboration between different stakeholders in the market.

#### 4.3.2.2 WBSO
The goal of this WBSO subsidy is to fiscally stimulate companies to do innovation, while it refunds a part of the wages of the employees for research design and innovation activities. It refunds fifty percent of the first € 220.000 of wage a year and eighteen percent over the rest of the wages if it above that amount. For younger companies a starting bonus is giving, hence the fifty percent is brought up to sixty-four percent refunding. The overall goal is to make innovation activities cheaper, especially for SME’s.

### 4.4 Internal analysis
This section goes more into depth focusing on the specific business models being used by companies in and out of the space-sector. Looking at open innovation by means of a business model approaches towards the space and the non-space-sector some interesting aspects showed up. The business models in the space-sector were not as universal as was expected on forehand. Small space companies are mainly founded because of the fact that they possess a technology which makes them unique in the market. Larger companies that do not work into space try to work more structured, with organized structures and formal partnerships. In the upcoming section the internal factors of a business model will be discussed. Companies were analyzed based on the nine different business model aspects of Osterwalder (2010, combined with the open innovation literature). The aspects were analyzed individually and furthermore the relation between these different aspects was an area of interest. The analysis of all the nine aspects of the business model is presented in Appendix III, and as an illustrative example one of the nine aspects is presented in section 4.4.1.
4.4.1 Value proposition

The first aspect that is looked at is the value proposition of companies, and specifically what value they bring in open innovation projects. Interviews have shown that the smaller space companies often focus on product leadership. They have a certain technology or production technology they possess and this technology is brought to the open innovation project. This technology has most of the times no concrete use yet and space is on the markets they try their technology on. It is illustrated by the following two quotes.

CEO of a small space company: ‘Value proposition is mainly based on technology, because our technology is unique in the world and just a limited number of companies are capable of doing we can’.

Head of R&D of a space company: ‘In space you need to focus on high end, so the top of the bill, making the best products which only a few companies can do.’

Larger space companies and non-space-sector companies are focusing on different values. Some larger space companies try to focus on customer intimacy, mainly the ones that have commercial aspirations. Companies that are not working in the space-sector try to bring in a mix of their values in open innovation projects. An illustrative example what should up in interviews was that these companies mentioned to bring in the best of all worlds, but with a specific eye towards customer intimacy.

Head of technology of a medium sizes non-space company: Our business model is based on customer intimacy as you might have noticed during my story. The value we add is mainly quality based, but the quality must be preset by the customer.

Head of research department of a large non-space company: The value proposition is mainly based on the customer. If the customer wants lower throughput times or other specification this is the most important focus area for our company.

This fits with the research of Tallon (2008), while he states that companies should possess different values in order to maximize their added value to the product of service. These findings are complemented by the research of Chesbrough (2006), who mentioned that focusing on technology and solely improving the quality of their products this is disastrous for open innovation. This is supported by this empirically evidence from the interviews, which are graphically represented in table 2. Concluding you can state that most of the smaller space companies do focus on product leadership, because they possess a technology that they want to put in many markets. You see that space is a market that techno start-ups really want to explore to try their technology on. The non-space companies differ more in value propositions, while they are more focused towards the customer.
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<th>Non-space</th>
<th>Value Proposition</th>
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<td>Product Leadership</td>
<td>Non-space 1</td>
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<td>Customer Intimacy</td>
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<td>Space 11</td>
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Table 2. Value propositions of space and non-space companies

### 4.4.2 Internal cross dimensional analysis

Besides having analysed all different aspects of a business model on an individual level it is even more interesting to look at the relationships between these different aspects. Figure 8 shows all hypothetical linkages that Osterwalder et al. (2010) thought that they might be related to each other. The upcoming section describes the empirical data analysis which tested several hypotheses.

![Business Model Diagram](http://bussiness-model-design.blogspot.com/2005/11/what-is-bussiness-model.html)

Figure 8. Osterwalder et al. (2010) Nine point decomposition of a business model
4.4.2.1 Focus of the company

A first interesting discovery was made when the value proposition and the customer relationship were put next to each other. When companies had a product leadership or an operational excellence strategy, they were less involved in building customer relationship. If companies had a customer intimacy strategy they were more active in using tools to enhance the relationship. This was combined with an interesting aspect at key resources and key activities. Most of the product leadership oriented companies showed evidence that the most important resources were technology oriented. Regarding their key activities they stressed on the fact that they are R&D driven, or that doing innovation is their main daily activity. It seems that these four aspects (Value proposition, Client relationship, Key resources, and Key activities) are closely related. The strategy of the company is leading, and translates itself into the key resources which will lead to the key activities. When the focus is more on customer intimacy, customer relationships are seen as more important and tools are used to enhance these relationships. To give an illustrative example three quotes of one company out of the space-sector are given below.

Question about the value proposition: ‘We are extremely R&D driven’

Question about key resources: ‘We think that we bring in our measurement tools…..’

Question about customer relationships: ‘We are still in the innovation phase, and are busy setting up research programs. We are not yet active in setting up customer’s ties’.

Another company that is active in the space-sectors described his company as being good at one of a kind products which others can’t make. They stated that they have special machinery as the most important resource. Furthermore they mentioned that they only use personal contact in order to keep in touch with the customers. Finally a R&D manager of a space company stated they produce high end, top of the market products that just a few companies are able to produce. He described the most important activities as innovate, design, and produce innovative products for space and aerospace. The interviewee mentioned that he was not aware of any tools for customer relationships. This empirical evidence suggests that there might be a triangle linkage between key activities, key resources, value proposition and client relationships.

4.4.2.2 Indirect distribution channels and customers relationships

A relationship between customer relationships and distribution channels might also be present according to Osterwalder et al. (2010). Empirical evidence showed that when a company had a direct distribution channel, it will have a stronger customer oriented focus and will be more active in setting up customers relationships. With the use of indirect distribution channels, the company moves farther away from the end customers, which makes them less motivated to set up the relationship with the end customers. Most of the companies interviewed outside the space-sector had direct distribution channels. It seems that they are more active in setting up the customers relationships, with the help of CRM tools.

Head of engineering of a non-space company: ‘We are having direct customers relationships, and realize that is it harder to get new customers than keep the existing ones’

Head of engineering of a non-space company: ‘Direct distributing it to the airlines and we do not make use of integrators or value adding distributors.’
R&D engineer of a non-space company: ‘Distribution is not done via VAR, because we want to sell directly to the customer, so we are close to the wishes of the customer.’

R&D engineer of a non-space company: Customer relations are very important; we want to stay very closely related to the market.

Another manager of a larger company which is active in the space industry told that they make use of direct distribution channels, and that they want to be close to the customer, which requires certain strategies and tools. More empirical evidence was found that if companies made use of direct distribution channels, they dedicate more time and effort towards customer’s relationships.

4.4.2.3 Complementarity
Almost all companies told that, in shared innovation projects they want to work together with partners that bring in different resources and different key activities. Open innovation projects are mostly carried out, because one single party doesn’t possess all the knowledge and all the assets to do it on their own. If a company is very good at a specific part of a satellite, they might try to work together with a partner that has expertise and machinery to make solar panels. An empirical link might exists between partnerships and key activities/key resources. An illustrative example is given below, from two interviewed companies that are also strategic partners of each other.

R&D manager space: ‘We look for complementary values so that the companies are additional to each other.’

Business manager Space: ‘In our collaborations in R&D we look for a partner that has complementary knowledge.

R&D manager space: ‘We bring in innovation capabilities, and hardcore factual knowledge about the technology that we bring in.’

Business manager Space: ‘We build high quality ***** parts, for satellites and launchers.’

This is an illustrative example of two companies that both state that they are looking for complementary in their key activities. They work together and bring in knowledge both on a different technology in order to create the best of both worlds. When they bring in their own key activities, key resources will follow. There might be a relationship when companies search for complementarity in their partnership, key resources and key activities of these companies differ in the shared innovation project. This is backed up by evidence from Amit and Zott (2010), pg 14, while they state that ‘value that will be generated through publishers’ new business models will be created through the complementarities and interdependence among activities, and through the enormous efficiencies in the publishing process that the new business model enables’. This means that companies should look for efficient ways to bundle strengths by means of looking for the complementarity in their business models.
4.5 External analysis
The external analysis deals with factors that companies have no direct influence on. All six aspects are analysed and are presented in appendix IV. In this section one illustrative example of an external factor is given and a cross dimensional analysis is presented.

4.5.1 Political
The first external factor that is being analyzed is the political situation. More specifically how the current political situation fosters or inhibit the collaboration with partners for shared R&D. Smaller space companies are not amused with the current political situation. The whole sector agrees that budgets are being cut down and the most important subsidy rule PEP ⁵ (Prekwalificatie ESA Programma’s’) is being cut by thirty per cent, which makes it more difficult to get governmental support for innovation activities. Others tried to look at it from the bright site; hence (Aero) space is one of the focus areas of the Dutch government. Companies react to this by focussing on one or a few project instead of on their whole portfolio.

R&D employee of a non-space company: ‘The innovation budgets in going down, due to political decisions.’

Business developer space:’ Political budget ‘factors inhibit the innovation projects in the economic crisis now.

CEO of a space company:’ We keep the lower R&D budgets in our mind, by looking at the ESA’s areas of interests and try to adjust their research direction to it.’

Smaller SME’s from the space-sector did ventilate some remarkable observations. In their opinion the funding is very political, which means that the money flows to the government oriented companies. Some companies that are longer in the space market get easier access to funding and subsidies according to the SME’s in the space-sector.

CEO and founder of a space company: ‘The economic crisis caused politicians to cut the funding budgets. EU is giving money to the ESA, ESA gives it back to government driven companies or institutes.’

Most of the companies that were interviewed were working with (scientific) research institutes to test or co-develop their product. Examples of these institutes were TNO, NLR, and SRON. There was no difference between space and non-space companies regarding this topic. The companies see the value of these institutes and try to make use of them.

Product specialist of a non-space company: ‘It is important to work together with universities. R&D funding needs to be there, nowadays you see that institutes need the flow on money although these economic times.’

⁵ http://www.spaceoffice.nl/nl/Het%20NSO/Subsidies/PEP-regeling%202011/
4.5.2  External cross dimensional analysis
Besides having analysed all external factors on an individual level it is also interesting to look at the relationships between these different aspects. This external cross dimensional analysis looks how the factors are interrelated.

4.5.2.1 Political and technological factors
The relationship between the political and technological factors is a quite obvious one. Political factors deal with how the government is stimulating the space-sector in order to be more productive. Nowadays the space-sectors states that budgets are being cut down and the most important subsidy rule PEP is being cut by thirty per cent, which makes it more difficult to get governmental support for innovation activities. The technological aspect is focused on how companies deal with research funding, so that makes the two aspects related. When the politics decide to cut the budgets of subsidies the companies have to take react to this action. If there is enough money available and it is easy for the companies to acquire the money companies might get negligent in planning their R&D programs.

CEO and founder of a small space company: ‘We now try to plan our R&D, which is extremely difficult.’

Business manager space: ‘We solved it by making choices. We made conscious choices what to prioritize and what quality we want to achieve.

R&D manager space: ‘We need to make strategic choices, our innovation pallet is very broad, so some programs should drop out.’

Most of the companies tried to solve the political decisions why narrowing their innovation programs. The might be very cyclically sensitive, because in economical good times companies politics have a lot of funding available it is easy to access funding. When the times are less flourishing politics decide to have less money available for space, and the space companies try to react to it by focusing and narrowing their innovation projects.

4.5.2.2 Economical and social factors
A final linkages might be present between economic and social factors. The two constructs looked at if a company was able to change the business model in minor economic times. This analysis looked at if they were economical capable of doing this and if there was any social resistance in making these changes. It seems that there might be a connection between these two constructs. If a company mentioned to be capable to economically responsible change their business model, most of the times they mentioned that it was also socially doable. An example of a major industry company is given below.

Product specialist of a non-space company: ‘**** is capable to change their business model often.”

Product specialist of a non-space company: ‘It will not lead much resistance to change within the organization.’

This could be explained, seen the fact that if a company often changes their business model, the employees get used to these changes, which makes the interviewees state that socially it might not be a problem is an organization changes their business model. On the other hand, if a company has
never changed its business model before, and minor cyclically times arise, it would be harder for the
employees to deal with these changes.

4.6 Science technology innovation indicators (STI)
The last section of the analysis phase deals with which indicators firms use to measure their
technology and innovation programs. In the literature section a difference was made between input
and output driven indicators. The interviews showed that mostly output indicators are used in and
out of the space-sector, like return on investment. What was remarkable is that many innovative
companies did not use measurement criteria. If you look at the space-sector almost no criteria were
used when measuring innovation. If projects had to be carried out for the ESA, there were some
companies that used TRL levels as a measurement instrument, but furthermore almost none of the
companies were busy measuring their innovation trajectories, except for one space company. What
was often mentioned is that space companies were too small for measuring their innovation.
Complemented with the fact that the time that they have to invest in developing such a
measurement instrument is not the most efficient time investment. Table 3 shows all interviewed
companies and the type of indicators they use, and the statements made are backed by the following
quotes.

CEO and founder of a space company: ‘We don’t use indicators we are too small for it.’

CEO of a space company: ‘The use of objective criteria is not useful for us now, because we don’t
have the assets to put any time or effort in it.’

R&D employee of a space company: ‘In SME’s and SME’s that are doing business in space, you are
not doing batch based orders, so every project in unique, which makes it hard to develop indicators.’

Other interviewees told that indicators only should be used if the manager doesn’t know what is
going on at the company.

Head of advanced concept teams at a major space company: ‘Indicators are only used if the
management doesn’t have oversight what is happening in the company/department.’

A last area of interest was if the companies focus more on radical or increment innovation. Analysis
showed that the companies active in space focus more on radical innovation, while the non-space
companies focus on making their products better and cheaper. From the six interviewed non-space
companies, four of them were focusing on incremental innovation, one on radical innovation, and
one company mentioned to focus on both types of innovations. From the eleven space companies,
seven were focusing on radical innovations. Most of the space companies are technology driven so
that is the main reason why they focus on radical innovations, while larger companies have a proven
technology that they want to bring to the customer and improve it. Concluding you can state the
innovation indicators are rarely used. In the space-sector sometimes TRL levels are used and outside
the space-sector financial indicators are dominant.
Table 3. Use of indicators in space and non-space companies

<table>
<thead>
<tr>
<th>Space</th>
<th>STI indicator</th>
<th>Non-space</th>
<th>STI indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space 1</td>
<td>None</td>
<td>Non-space 1</td>
<td>No indicators used</td>
</tr>
<tr>
<td>Space 2</td>
<td>None</td>
<td>Non-space 2</td>
<td>Some financial indicators</td>
</tr>
<tr>
<td>Space 3</td>
<td>TRL level</td>
<td>Non-space 3</td>
<td>ROI, throughput improvement</td>
</tr>
<tr>
<td>Space 4</td>
<td>‘Commercial success’ and TRL level</td>
<td>Non-space 4</td>
<td>Some financial indicators</td>
</tr>
<tr>
<td>Space 5</td>
<td>None</td>
<td>Non-space 5</td>
<td>Patents, reports, successful tests, ROI</td>
</tr>
<tr>
<td>Space 6</td>
<td>None</td>
<td>Non-space 6</td>
<td>Quality perception</td>
</tr>
<tr>
<td>Space 7</td>
<td>Publications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 8</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 9</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 10</td>
<td>ROI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 11</td>
<td>None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.7 Conclusion of the analysis

In the initial problem statement was stated that open innovations in the space-sector were more or less driven by coincidence instead of a preselected strategy. An assumption that was made before the analysis was that companies in this sector were not doing innovations in collaborations. Analysis of interviews showed that this was not the case at most of the companies; hence they really focus on open innovations and trying to exploit them on the market. Secondly the initial statement stated that the appliance of innovations is an underexploited area in the European space-sector.

The analysis did result into a new insight into this same innovation problem. It showed that open innovation, in collaboration with the ESA, usually takes place at larger companies. Small and medium sized enterprises are not able to take part in the innovations tenders at ESA. SME’s told that they do not have a high chance to become a partner of ESA. Interviews showed that ESA was mainly focusing on the large leading system integrators, who are taking the complete tender. These companies are subcontracting other companies and institutes in order to work together with them to finalize the project. The current way of working by ESA is not making use of the full potential and expertise of small and medium sized enterprises at the moment. More support should be acquainted in order to maximize the potential of the SME’s.

The final paragraphs of the analysis chapter reveal the problems that are currently present in the space business. Problems which can be identified are placed into two categories, namely problems at ESA and problems which are occurring at SME’s in the space sector. These problems are the basis for the requirements for the proposed redesign.
4.7.1 Problems at ESA

The ESA tries to stimulate open innovation. In their invitations to tender, they try to bring different companies together in order to achieve synergy advantages from open innovation. They possess a lot of knowledge during their experience and expertise they gained in over 25 years of space business. Although a lot of knowledge is present at this agency, it is hard to acquire this knowledge by small and medium sized enterprises. ESA is active in stimulating open innovation, but they are more focused towards the inbound open innovation. Looking from a commercial company perspective this might be a right strategy. According to their website the mission of ESA is to ‘shape the development of Europe’s space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world’ (www.esa.int). Most of the interviewed space companies in the Netherlands stated that they think that it is very hard to do get access to the valuable data at ESA. In order to shape the development of the space capabilities of Europe, ESA should do more the knowledge they possess. Although they have several initiatives that try to foster outbound open innovation (4.2.2) still some steps can be made. They furthermore state that they strive for ‘coordinating the financial and intellectual resources of its members, it can undertake programs and activities far beyond the scope of any single European country’. The ESA wants to act as a knowledge broker between countries and companies, so inbound innovation might not be the right strategy to use in order to reach the maximum benefits of open innovation.

Furthermore, the ESA wants to bring radical innovation to the market. If a shift in focus towards more radical innovation is to be achieved, SME’s are the companies to work with. SME’s in the Dutch space-sector that were interviewed stated that it is hard for them to get in touch with the ESA, because they focus on larger established companies in the space business. The focus of the ESA seems more directed towards established companies in the space, and for smaller companies it is hard to acquire that knowledge, due to the inbound innovation strategy of the ESA.

4.7.2 Problems at SME’s in the space industry

Not only the ESA is debtor about the fact that the full potential of open innovation is underused, also the SME’s working in this industry own several problems which makes it hard for them to get the best result out of open innovation. Many companies that are working in the space industry are small and medium sized enterprises, so the final part of this summary of problems is dedicated to problems at these companies. One of the major problems is that SME’s in the space is mainly present at techno start-ups. They are very active in R&D and setting up innovation programs. This leads to a strategy which is called product leadership and is, according to the literature, disastrous for open innovation. This strategy leads to key activities and key resources that are technology focused, and this triangle of linkages is not positively related to successful open innovation. Most of the companies working in this sector are product driven and this lead to the fact that they neglect the wishes of their customers. Customer relationships (with other companies or LSI’s) are undervalued and are not formally set up. They don’t use tools to get gain new customers, or even more important, keep existing customers. This translates itself to a company that tries to work together with another company that also has certain technological values, and this reinforces the whole picture. These partnerships are not formally set, and no tools or systems are used to stay in touch with the partners. Partners are known for a longer period of time, and new partners are founded by coincidence.
When a techno start-up wants to solely focus on technology, a way to be more active in open innovation is to make use of patents and licenses. This is usually not done in the space SME’s in the Netherlands. They do not see the benefits of the use of licenses in order to work together with certain partners. Technology is important for these companies and maybe too important. They lose sight of other important aspects of business. You might expect that these research and development programs are set up in a very structured manner. Interviews have proven that not many companies were making use of innovation indicators and other structured procedures.

Concluding you can state that the intentions are there from the ESA and the space SME’s in the Netherlands to work together and to achieve a common space goal, however some aspects need to be changed in order to let these initiatives work out successful.
5. **Redesign**

The following section deals with one of the final phases of the regulative cycle. The first part of the redesign deals with the requirements which it must meet. Furthermore, the redesign itself consists out of two main parts related to the two problems described earlier. It starts with a section about the generic open innovation business model for technological SME’s in the Space sector. It sketched the different parts of a business model, and which business model should be applied by SME’s in space companies. The model by Osterwalder (2003) is the lead for the dominant design. Finally guidelines for the ESA were derived, which deal with the second problem described in section 4.7.1. The main goal of this final part is to ensure that ESA, with the help of these guidelines, could enlarge the chance of success with the help of the generic open innovation business model for SME’s in the space-sector.

5.1 **Requirements for redesign**

In order to be successful the redesign should meet several requirements, which seem to be important looking at the analysis. Requirements can be split into four different types of requirements (Van Aken et al., 2007). The first type of requirement is functional requirements, which describe the performance of the redesign. The second requirement describes the requirements from the viewpoint of the user. The third type is boundary conditions which are conditions that must be met unconditionally. The fourth and final type is design restrictions which are preferred solution spaces. Table 4 shows the requirements which need to be fulfilled in order to have a strong redesign.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Description of requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional Requirements</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Focus on SME’s and provide alternatives for SME’s</strong></td>
<td>Interviews were done at SME’s in the space industry (2.4.1) and to provide a founded redesign this will be the sector to look at. New Key Enabling Technologies mainly come forth out of radical innovations and ESA wants to work with companies that bring forth radical innovations (4.7.1/4.7.2). Furthermore the internal cross dimensional analysis (4.4.2.1) showed that not all SME’s works in a uniform manner, so several alternatives should be provided.</td>
</tr>
<tr>
<td><strong>Aiming to bring ESA and SME’s closer towards each other</strong></td>
<td>Interviews showed that the focus of the ESA is more towards larger companies, and the SME’s in space found it hard to get in contact with ESA (4.5.1). Brining these two parties together can have great synergetic effects (4.7).</td>
</tr>
<tr>
<td><strong>Working towards more outbound open innovation</strong></td>
<td>Companies that just bring in innovations do not contribute as much to the market. Companies that both focus on bringing in innovation and distributing these innovations to others are contributing more. Looking from a market perspective, outbound open innovation in much more viable. The ESA has a lot of experience that could be used by SME’s in and even out of the</td>
</tr>
</tbody>
</table>
Coordinating role for the ESA, EC and Dutch government

The problem statement was brought up by the ESA/ESPI, and they showed willingness to make changes in order to make improvements (1). ESA is the coordinating agency is the Dutch market, and almost all of the space projects are coordinated by them (4.1). The EC and the Dutch government should also play a coordinating role.

User requirements

Easy to use/understand

Not all companies have in-depth knowledge about business models and the applications of these models in their company. The model should be easy to understand for users in the field.

Design restrictions

Should focus on factors that can be changed (internal factors)

External factors are factors affected by, for example, the government or the economy, which makes them hard to target. Internal factors, seen from a company perspective, are adjustable buttons, which make them more appropriate to target.

Business model oriented

The thesis focused itself on business models already in the literature analysis (3). Furthermore business models give a broad overview of the strategic and tactical decisions of a company. (3.2)

Table 4. Requirements for redesign

5.2 Design of generic open innovation business model

The third research question, in section 1.4.1, was directed towards what could be done to re-innovate the current business model of the space-sector. While this is very broad, (space can’t be captured in one generic company model) it is still interesting to combine literature research with empirical findings in order to provide guidelines how to establish a business model which sets a good foundation for open innovation. The interviews were mainly conducted at SME’s in space, so this generic open innovation business model is also focused towards SME’s working in the space-sector. The basic model by Osterwalder (2003) is filled in for all different aspects in order to maximize the result of open innovation in figure 9. Each individual aspect of a business model is discussed in the appendix V. In the upcoming section an illustrative example about the value proposition shows how the individual aspects can be focused towards more open innovation. The generic open innovation business model fits all of the, in chapter 5.1 described requirements for redesign, except the coordinating role for the ESA. This is because this model is specific for SME’s active in the space-sector. The ESA guidelines are described in chapter 5.3. Alternatives are discussed in chapter 5.2.2.

http://www.esa.int/SPECIALS/About_ESA/SEMSN26LARE_0.html
Osterwalder Business Models

Figure 9. Adapted from Osterwalder (2003) schematic representation of a business model, filled in for maximizing open innovation

5.2.1 Value proposition

The upcoming paragraph will describe the value proposition as it is displayed in figure 9. As stated earlier, this is done for every individual aspect in appendix V. Literature showed that there are three main value propositions, namely operational excellence, customer intimacy and product leadership. Literature suggested that product leadership was not the right choice for open innovation, while the focus would be just on the quality of the internal product. Interviews have supported this fact, hence small space companies focus more on technology, while companies that are known to be very innovative focus more the customer relation. The non-space companies differ more in value proposition, but are more focused towards the customer. Three main conclusions can be drawn from the interviews and the literature.

- Companies should not solely focus on product leadership.
- Companies should try to direct their value proposition towards the customer.
- In open innovation complementary values should be brought together to reach maximum advantage.

5.2.2 Design of business model alternative configurations

This section provides several alternatives how SME’s could arrange their business model for maximal open innovation capacities. These alternative configurations are sketched, because not every single company can focus on all different aspects of a business model directly. A comparison could be made with different options packages provided when buying a car. In a sport package, you get sport chairs, different rims, and a spoiler. You won’t get leather lining, or parking sensors as in the business.
package. This alternative design works the same here. Different predefined configurations of the business model were made, such that a company has the choice which alternative they want to implement. Table 5 describes where each alternative focuses on looking at the nine different aspects out of the generic open innovation business model.

<table>
<thead>
<tr>
<th></th>
<th>Customer orientation</th>
<th>Exploiting innovation</th>
<th>Network orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value proposition</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Target customer</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Distribution channel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Customer relationship</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Key activities</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Key resources</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Partnerships</strong></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Cost structure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Revenue model</strong></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Table 5. Alternative configurations

5.2.2.1 Customer orientation
The first alternative would be to focus the business model more on the final customers of the SME’s in the space sector. This starts with proposition, a value which should be directed more towards the customer. Customer orientation leads to more open innovation. This translates itself to a different attitude in customers’ relationships. Management tools should be set up in order to keep close contact with the customer. The customers should have influence on the research and development process in order to let the wishes of the customer influence the research of the company. Most of the companies have the assets already to make technological products, but are focused inwards. Companies should also try to work with customers that are not usually in the space-sector. On the edge of different disciplines new ideas arise, and companies should make more use of it. One of the key resources that should be exploited is the use of open source software.

Together with other companies and customers ideas should be exchanged in one language, so that this triangle of companies and partners work together in the same language. R&D activities should be more outward orientated and customers should be involved in this process. Customer orientation starts with the value proposition, but spreads itself through many different aspects of the business model. Customer orientation is the right strategy to use when there is a lot of competition in the market, so the customer has a lot of options. Another market feature is that the market asks for unique products, which should be fine-tuned by the customer. If a company sees that customers have special wishes that they want to have in the product in order to buy it, this might be the right strategy to use.

5.2.2.2 Exploiting innovation
The second alternative would be to be more exploiting the innovations. If a company goes for the product leadership strategy, they must focus everything on structuring their innovation. Measurement tools for measuring the innovation should be set up, in order to keep track of the innovation. Furthermore contracts, non-disclosure forms, and other legal instrument might help to
get a structured innovation process. The innovations that come out of these innovation processes should be protected by the means of patents. These patents can be used for exploiting the innovations, which is also good for open innovation and especially for outbound open innovation. Formal relationships can be set up in order to work together with partners in and out of the space-sector. To adjust this redesign more towards space, companies should work with the TRL level model as described in 4.2.1.2. This brings SME’s and the ESA closer to each other, because it forces them to speak the same language. A uniform manner of working through your innovation leads to more structure and better outcome of your innovation process. More specific they should look what technologies they possess, and how this could match with complementary activities or technologies of other companies. Bringing this could lead to advantages. Exploiting innovation is the right strategy to use, when a market is innovation dependent. You need to bring something new to the market in order to stay competitive. In very technological markets this might be the right strategy to use.

5.2.2.3 Network orientation
The third alternative is to focus more on setting up relationships with partners and customers. Research has shown that formal close relationships are good for open innovation. Close relations bring more open innovation for the company. It must be directed in the space-sector, but also outside the space-sector in order to bring two different technologies together on the edges of sectors. Relationships need also to be set up with customers, so that customers can help the company in order to make better innovations. Tools that can be used are customer relationships management software, but also open source software in order to co-develop products. Not only relationships with companies and institutes need to be set up, but also relationships with the politics. They should visit brainstorm sessions, common space meetings and other forums where they could speak with other space related companies. The initiatives of setting of these meetings should be with the SME’s. It has two main advantages, because firstly small SME’s together could form a consortium and are a bigger party towards ESA and second they have the capacities to setup these forums, and know which are interesting parties to work with. The strategy forces the company to be very fluid and the company should possess capabilities which allow them to adapt and respond very quickly. This is needed when research money is flowing towards other areas, where no past projects were carried out. When a company is funding dependent and has not enough financial power to do innovation activities by themselves, the network orientation alternative seems to be the right choice to go for.
5.2.3  Testing of generic open innovation business model

The final section of the redesign is the testing phase of the generic business model, and the alternatives presented. SME’s should make use of this model to enlarge the open innovation capacities, so the testing of the business model took place at four different SME’s in the space-sector. Due to time restraints not all redesign directions could be tested, but the business model part was selected for this testing phase, because it was dominant during the analysis. Another justification for this is that most adjustments to the model could be made with the help of SME’s in the space-sector.

5.2.3.1  Test set up

The case that was presented to the interviewees was how they would arrange their business model in order to acquire the maximum result out of open innovation. Most of the SME’s mentioned in the first interviews that they were focusing on innovation and nothing else, because of the fact that they had limited resources and were still in the pioneers phase. To get the interviewees out of this dogma, the case was presented as they were ahead in time, and that the company had unlimited time and resources to establish a business model how they wanted it to be. After the answer of the interviewee, the generic business model was presented to that person. When the interviewee finished his comments, the alternatives were presented to them, and were inspected for their opinion. The reason for not presenting the model at once is to not let the interviewee be prejudiced about how to set up a business model for open innovation. The steps are described below.

- Present the business model case as the company would have unlimited resources
- Present the generic open innovation business model
- Present the alternatives

5.2.3.2  Field test

The first company describes that they want to focus more outside the company if they had more resources. The service and sales should be brought to the next level. Besides this they want to make their engineering capacities even stronger, like more diverse machinery and tools they can enhance their engineering process. After discussing the different aspects of the business model, these were the main aspect they want to change if they would have all resources.

This company thinks that the model is more suited for the production industry, and that an OEM company has much more affinity with this model. For this company the marketing manager space sees some interfaces with the model, and he thinks that the model is suitable for technological companies in the space-sector. As minor change he suggests that in open innovation you should be open, which means sharing as much information as is possible. In the target customer section he states that you should not make use of non-disclosure forms, while this might be bad for open innovation. Another suggestion that was done is to make use of shared patents, which makes a project of you both. The strategy that fits the most to their company was customer orientation. They have all the assets already present, and they want to get closer to the customer in order to fulfill their wishes. This requires a sales network, and being able to translate the wishes of the customers towards the engineers. The engineers with their company should work together with customers and engineers of the customer. Furthermore he states that the strategy depends on the place of the company in the value chain, and if they make an end product, or are just a distributor in the chain.
The second company told that they moved away from a high tech space oriented company, towards a more integrated company. He states that they started to focus more on customers to reach the next step. Making demonstration models for the customers, to get them closer to their company was one of the tools they used to move from a technology oriented company to an integrated company. The company wants to focus more, if they had all the resources, on getting closer to the Dutch research programs. This would make it easier to access funding and subsidies, which are vital in the space industry.

The business manager space of this company states that he does not believe that collaboration between companies out of the space-sector and different sectors could deliver radical open innovation. This is because of the fact that space is such a unique market that it very complicated to work together. Laws and rules are way more specified, material in for example the car industry is bought in in bigger numbers, with lower quality. Even within the different departments in his company it is hard to work together. In theory it might be the best solution, but practice shows that it is very hard to apply. Further he states that measuring and structuring TLR levels are vital for structuring the innovation processes. The table should only consist out of short words, so that it will be better readable and understandable. The business manager space choses a combination of the three alternatives, because the philosophy of the company is that they want to combine all different business strategies in order to get synergic advantages.

The third company stated that if they had all the time and resources available, they would focus more on their sales network and their sales activities. The CEO states that they do a lot of research, because they operate from a technology push conviction. If they had more time and resources, the sales activities would be the first area which they would adjust. Furthermore he would create more focus in the R&D activities, so that they really focus on one key innovation.

The CEO thinks that formalizing innovation is disastrous for open innovation, because you need to create open informal atmospheres in order to maximize benefits of open innovation. He believes that you need to bring the technology oriented people together, and set them together in an informal atmosphere. Looking at the value added reseller, the CEO states that this is not a partner for research in the innovation phase, hence they have no financial incentives. It is better to innovate together with the final customer, because they do not have a different agenda like other research partners. Patents and legal contracts theoretical might work, but in the status quo it doesn’t work that good. Large multinationals can win any legal case in the eyes of the CEO of this company, which make patents useless. Furthermore he states that open innovation is difficult for small companies, because the process mainly occurs on system integration levels. The model is more suitable for larger companies, because small companies do not have any legal departments. Concluding you can state that this person didn’t believe in the model. He sees some good aspects in it, but he classifies the model as too formal.

Customer orientation is the direction, where the CEO would go for. This is related to the direction they would go for if they had unlimited assets and resources. Mainly because the company is already good innovation processes and can still gain profit in this direction.
The fourth company stated that if they had all the time and resources available, they would focus more on partnership. The would work more often together with customers and partners. The executive vice president mentioned that they possess a very unique technology, but that they realize that they should work together with others in order to bring the product to the market.

The vice president worked throughout all different aspects of the model, and he kept saying that he was really enthusiastic about the model. He thinks that R&D collaborations are very good and this should be related to clients. He furthermore thinks that space should always be a niche of a techno start-up, because it is very hard to just focus in the space-sector. According to the value proposition he thinks this is one of the strongest points of the model. You cannot do everything yourself, so you should work together. According relationships, provisional collaborations as in testing collaborations could help in order to let you know the partner where you are working with. This could be combined with R&D collaborations. Relationships should be maintained via personal contacts instead of CRM tools according to the vice president of the techno start-up in the space-sector.

Customer orientation was the choice of the vice president of this space company, because in his opinion you need to search for applications of your technologies in order to be successful.

5.2.3.3 Conclusion of testing

Based on the test interviews the improved model is shown in figure 10. The first adaptation is the readability of the model, which has been improved by decreasing the words in the table and replacing the sentences by key words. The in-depth description of each point is located in appendix V for further explanation. Content wise some minor changes were implemented to make the model better understandable as in Key Activities happened and Key Partners. Furthermore in Revenue Stream the importance of subsidies is now addressed, because all companies told about the need and the importance of making use of subsidies. Adaptations were made at the clients, because shared R&D test projects can function as a startup for further open innovation. Some companies mentioned that patents could work counterproductive, but others stressed the importance it could have. This was also the case for formal CRM tools, which could help, but personal contact is at startups maybe better. Finally adaptations were being made at the clients, because all interviewees marked that have formal agreements with customers and research partners is not good for the openness and trust in the open innovation setting. They stressed on the importance of openness and informal settings in order to get gains out of open innovation. A summary of the company’s reactions is given in table 6.

Three out of four interviewed companies were positive about the generic open innovation business model. One interviewee from a space company said that the model did not impress him. This might be caused due to the fact that the company works from a technology push perspective. This type of company is really focused on their specific invention, and is paying less attention to other parts of the business model, which makes them have less affinity with the complete picture of business models.
<table>
<thead>
<tr>
<th>Business model</th>
<th>Usability</th>
<th>Alternatives</th>
</tr>
</thead>
</table>
| **Company 1**  | - Informal settings, open environment  
                 - Funding | - Readability was not good due to long sentences | - All alternatives were dealt with |
| **Company 2**  | - Informal settings, open environment  
                 - Funding | - Readability was not good due to long sentences | - All alternatives were dealt with |
| **Company 3**  | - Informal settings, open environment  
                 - No VARs  
                 - No Patents  
                 - No Formal criteria | - Model not concrete enough/Open innovation is hard to capture in a model  
                            - Open innovation more for bigger companies | - Alternative that dealt with capturing innovation, was too formal |
| **Company 4**  | - CRM vs. Personal contacts  
                 - R&D test projects  
                 - Funding | - Unclear term used, like product leadership |   |

Table 6. Summary of testing companies
5.2.4 Improved generic open innovation business model

The input given by the four tested companies finally led to an improved generic open innovation business model (figure 10). Content wise partnerships, clients, relationships and revenue streams are adapted based on the input from the space SME’s. Looking at the user friendliness of the model, the sentences are made shorter and are stated now by means of key points. Furthermore the ambiguities in the model are clarified now, so that the model is better understandable for user in the field.

Osterwalder Business Models

<table>
<thead>
<tr>
<th>Key Partner</th>
<th>Activities</th>
<th>Value</th>
<th>Relationships</th>
<th>Clients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close contacts with customer and partner relations</td>
<td>Not focusing on solely development activities</td>
<td>Not solely product leadership</td>
<td>Balance CRM tools and personal contacts</td>
<td>Create informal and open settings with customer s and research partners</td>
</tr>
<tr>
<td>Base contact frequency on project phase</td>
<td>Focus key activities &amp; R&amp;D outside the company</td>
<td>Customer oriented value proposition / or a mixture of value propositions</td>
<td>Criteria for partner selection</td>
<td></td>
</tr>
<tr>
<td>R&amp;D test project with partners</td>
<td>Open source software</td>
<td>Complementarity values should be brought together</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use resources to innovate together outside the space sector</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Resources</th>
<th>Key Activities</th>
<th>Value</th>
<th>Key Activities</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation costs should be assigned project dependent</td>
<td>Not focusing on solely development activities</td>
<td>Not solely product leadership</td>
<td>Use patents and shared patents</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Focus key activities &amp; R&amp;D outside the company</td>
<td>Customer oriented value proposition / or a mixture of value propositions</td>
<td>Exploit patents by means of licenses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open source software</td>
<td>Complementarity values should be brought together</td>
<td>Use of subsidies in open innovation projects</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use resources to innovate together outside the space sector</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 10. Adapted from Osterwalder (2003) schematic representation of a business model, filled in for maximizing open innovation
5.3 **Design of ESA, EC and Dutch government guidelines**

This part of the redesign deals with how the decision and policy makers including European Space Agency (ESA), EC and the Dutch government should help and facilitate SME’s in order to be successful in open innovation. The focus is on SME’s, because if you want to achieve radical open innovations, this is the group to target. This is because the ESA mentioned that they want to focus more towards radical innovations and literature has shown that most of the radical innovations come from SME’s. This guideline section consists out of two parts. Firstly how the ESA, EC and the Dutch government should be more active in outbound innovation, and secondly where they should focus their research direction towards. This research did not make a black and white distinction between space to space open innovations and space to non-space innovations, but it tries to find solutions for both of the types of open innovation. It matches a final requirement, because this design of ESA, EC and Dutch government guidelines focus on the ES, the EC, and the Dutch Government and tries to bring the ESA and SME’s closer towards each other. This will make the circle round, since all requirements are met.

5.3.1 **Increasing outbound innovation**

The first recommendation to the ESA, EC and the Dutch government would be to be more active in (outbound) open innovation from space to space companies, but also from space to non-space companies. Due to several decennia of innovation practice the ESA has gained a lot of experience with innovation and open innovation projects. ESA is mainly focusing on gathering innovation, which literature has described as inbound innovation. To gain more benefits from open innovation, the ESA, EC and the Dutch government should be more active in outbound open innovation. SME’s in the Netherlands told that the ESA is very good in gathering a lot of information, however redistributing the gained information is a focus area of the ESA. This knowledge could be very useful for companies in the space sector, but also out of the sector, hence radical innovations are mainly done on the edges of disciplines. To be more active in outbound innovation and to enable the qualities to enhance the key enabling technologies two main concrete guidelines are presented.

The first guideline is making use of knowledge database. According to the literature open innovation can be stimulated if a party with the knowhow uses licenses so that another company can use that knowledge. Looking at the fact that the ESA has so much knowledge of previous projects, the knowledge should be used in order to bring the innovation to another level. A general database should be set-up with all project ever carried out, so that companies could look if they could do anything with previous innovated technologies. Small techno start-ups in the space sector could benefit by this system, because they have a certain technologies, but need to develop it further in order to make it useful for a practical purpose in space. If they have access to knowledge, which could be patents or other technology related knowledge, they could develop their technology further and make it suitable for space practice. This outbound innovation initiative of the ESA or other similar initiatives by the EC and the Dutch government will be used to bring other companies together. In order to make this more patent specific, legal experts should take a look how this could be arranged. A start could be to set up a knowledge database, which is commonly accessible by companies that have a technology and want to make it applicable for the space industry, which is an example of innovation from space to non-space.
The second guideline is to make use of open source software. If the ESA, EC and the Dutch government succeeds in setting up an open innovation platform with the knowhow possessed steps could be made from an inbound focused sector towards an outbound focused sector. An open source platform would bring in companies together, and facilitate companies work to work together, while they speak each other language then. Literature showed that this could lead to more innovation, combined with the empirical evidence that space companies told that the ESA possess a lot of viable knowledge, but is hesitant to distribute this knowledge. This initiative brings companies together and helps the ESA, EC and Dutch government to bring their knowledge into the market.

5.3.2 Focus towards other contractors

A further guideline for successful implementation is to focus the tender projects towards SME’s. Most of the breakthrough research comes from small and medium sized enterprises in the market. Larger companies try to make their product better and cheaper, but are seldom active in radical innovation activities. There is a tendency under Europe 2020 strategy of the European Union to foster companies to do research in key enabling technologies. Empirical evidence showed that ESA is mainly focusing on larger companies inside the space-sector. It is very hard for small SME’s in space to come into the world of space of some managers and CEO named it. They described it as a small closed world where it is hard to get inside that world. A recommendation would be that ESA, EC and the Dutch government should focus more on SME’s. A practical appliance for this change of research direction in the case of ESA could be to further enhance a set of maximum to employees or turnover in their invitation to tenders (ITT). This enlarges the tender chances of SME’s. Managers and CEO’s of SME’s stated that they don’t have any chances in these projects, because of the fact that the larger companies have ties with the ESA. Changing this direction would enable the SME’s in space to bring their radical innovations in the space sector. More than half of the interviewed people in the space sector stated that a lot of bureaucratic rules were present, and that SME’s didn’t have the time and assets to pay attention to all kind of rules.

A last guideline for the ESA, EC and the Dutch government would be to focus more outside the space-sector by means of outbound open innovation. New and radical innovations are born on the edges of disciplines according to literature and empirical evidence. Nowadays the space sector is dominated by companies that have been active in space for a longer period of time. To bring some new fresh ideas into space, different flavors should be added in the status quo. The ESA, EC and Dutch government should design invitation to tender which oblige the main contractor to work together with at least one or two companies that have their main activities focused outside the space-sector. This will make space have to work together with other segments in the market, in order to create new radical inventions through open innovation.
6. Conclusion & Discussion

6.1 Main findings

This study has explored the Dutch space-sector, with two different focus areas. The first area of interest was the Dutch space-sector, and secondly the coordinating role of ESA, the EC and the Dutch government was looked at. During the master thesis, the main goal was to create more open innovation in the space-sector, so that key enabling technologies could spread among the space-sector. In order to achieve this goal the following research questions were set up:

1. How does the current business model in the European and Dutch space-sector looks like?
2. How does the business model, focusing on open innovation, of the Dutch space-sector differs from the business model of high innovative sectors?
3. What can be done to re-innovate this current business model of companies in the Dutch space-sector?
4. How can the ESA, the EC and the Dutch government stimulate the market to get more benefits from open innovation?

These research questions were answered by; on the one hand, a literature analysis which tried to connect business models to open innovation. And on the other hand an empirical analysis among space companies/institutes and high innovative companies in the Netherlands.

The first research question dealt with a description of the European and Dutch space-sector. This is described in chapter 4, where an individual description is given about the Dutch and European sector. The European space sector coordination of activities and funding is stimulated by three main stakeholders, the European Space Agency, the European Commission and the Member States (e.g. the Dutch government). However, it seems that most of the space activities in the Netherlands are coordinated and funded by the ESA, and that just a handful of companies that tries to work in the space on commercial grounds.

The ESA has a special website (EMITS), where they place procurement tenders on and companies are free to react on it. ESA mainly works with procurements. Dutch companies can react on these tenders in order to bring in projects. Most of the space companies are just suppliers for a few large space companies that have the capabilities to accept such a large tender. The Dutch sector contains around thirty space-aimed companies, where around five companies are fully dedicated to space, and two companies work commercially in this sector. This is complemented with five research institutions that try to support the market. Two main fundings are available, where the PEP is the largest and most space related subsidy fund. The other is called the WBSO, and is relevant for all companies that are active in innovative activities. In conclusion, the aggregate of this answers the first research question.

The second research question goes into further depth regarding the business model of specific companies. Osterwalder (2003, 2010) made a predefined business model which consists out nine different components. Literature analysis connected these nine different aspects to open innovation features which were described in other fields of the literature. Seventeen different companies were interviewed, which included the ESA, in order to get information about how companies equiponderate their business model. Six of these companies were companies that were not active in the space-sector and mentioned to have a lot of affinity with innovation and more specific open
innovation. As a starting point an expectation was formulated about the amount of open innovation in the Dutch space-sector. The empirical analysis has shown that most of the companies in space make use of a high amount of open innovation, because they need to work together in this sector. Companies mentioned to be too small in order to work solo in this market. Some differences with highly innovative markets were found, where space companies try to focus more on the technology aspects, and neglect other important aspects. They are very active in R&D and setting up innovation programs. This leads to a strategy which is called product leadership and is, according to the literature, disastrous for open innovation. This translated itself throughout different aspects of the business model; hence the value proposition, client relationship, key resources and key activities seem to be linked with one another. Further evidence was found that the space sector uses more indirect distribution channels, which are good according to the literature, but positions a company away from the customer. This translates to a company that tries to work together with another company that also has certain technological values, and this reinforces the whole picture. Other sectors have a better balanced business model, so that all different values of the model help the company to be active in open innovation. A final remark should be made about open innovation. It seems that the space-sector, including the ESA, is active in open innovation, but mainly on the inbound side. Companies try to get knowledge in their company but are hesitant to give knowledge away. Concluding, it can be stated that these are the differences between the space-sector and other innovative sectors.

The third research question deals with the solution design which shows what can be done to re-innovate the current business model of companies in the Dutch space-sector. This research questions is answered by means of a generic open innovation business model as being shown in figure 10. The model is set up, with the help of the literature (3.2) and the empirical evidence which was analyzed in section 4.4. Due to the fact that model needs to be used in practice, a testing phase was walked through, so that users in the field could share their opinion about the model. This made the model stronger, and three out of the four test persons were enthusiastic about the model. It is hard to say that the whole space-sector should use the entire business model, but they should try to adjust their business model with different elements from the generic open innovation business model. To help the different companies with it, several preset configurations were being made in chapter 5.2.2, namely customer orientation, exploiting innovation, and network orientation.

The fourth research question focusses on how the ESA can stimulate the market to get more benefits from open innovation. This solution design is in twofold. The first solution aspect is that the whole space-sector should be working more with outbound open innovation. This would create a more open atmosphere and the ESA has tons of experience with other project which they could share in order to let smaller companies get more access to knowledge. Methods that can facilitate this outbound open innovation are a knowledge database and open source software. The second solution aspect is dedicated to the ESA, EC and the Dutch government, while the analysis has shown that ESAs role is still the dominant director in this whole sector for the Netherlands.

It first states that companies should be provided with more access to knowledge such as access to licenses and open source software are method to provide access the knowledge particularly of ESA. Furthermore smaller companies in the Dutch space-sector have told that it is very hard for them to get directly in touch with the ESA, because the ESA mainly works with large system integrators. A
Dutch example is Dutch Space. Literature has shown that most of the innovative capabilities are located at SME’s.

There is a tendency under Europe 2020 strategy of the European Union to foster companies to do research in key enabling technologies. To make this applicable in practice, the ESA, EC and the Dutch government should do two things. Firstly, they should focus their procurement tender more on SME’s in the space-sector. Secondly, they should also look outside the space-sector while new innovations mainly happen on the edge of disciplines. Concluding, it can be stated that the ESA, EC and the Dutch government could play a large role as facilitator in order to reach the next level of (outbound) open innovation.

The fourth research question focusses on how the ESA, the EC and the Dutch government can stimulate the market to get more benefits from open innovation. This solution design is in twofold. The first solution aspect is that the whole space-sector should be working more with outbound open innovation. This would create a more open atmosphere and the ESA has large experience with numerous project from which smaller companies could benefit from by gaining better access to this knowledge. Methods that can facilitate this outbound open innovation are a knowledge database and open source software. The second solution aspect is dedicated to the ESA, EC and the Dutch government, while the analysis has shown that ESAs role is still the dominant director in this whole sector for the Netherlands. It first states that companies should be provided with more access to knowledge such as access to licenses and open source software are method to provide access the knowledge particularly of ESA. Furthermore smaller companies in the Dutch space-sector have told that it is very hard for them to get directly in touch with the ESA, because the ESA mainly works with large system integrators. A Dutch example is Dutch Space. Literature has shown that most of the innovative capabilities are located at SME’s. There is a tendency under Europe 2020 strategy of the European Union to foster companies to do research in key enabling technologies. To make this applicable in practice, the ESA, EC and the Dutch government should do two things. The first aspect is to focus on SME’s. Secondly, they should also look outside the space-sector while new innovations mainly happen on the edge of disciplines. Concluding, it can be stated that the ESA, EC and the Dutch government could play a large role as facilitator in order to reach the next level of (outbound) open innovation.

6.2 Contributions
The aim of the master project was to contribute to the development of an open innovation concept for the space-sector in Europe. This is carried out successfully, and this study provides both scientific and practical contributions for the space-sector. Most of the relationships focused on space-space type relationships.

6.2.1 Scientific contributions
In the starting phase of this study a literature analysis was carried out, in order to get a toolbox which would help tackle the research questions. The literature study started off with a model by Osterwalder (2003), where he distills a business model down into nine different aspects. These nine different aspects were linked with open innovation principles. The contributing aspect lies in the fact that some of these linkages were not made in the current literature. Chesbrough (2003, 2010) did extensive research on open innovation and how this could be fitted into business models, and this study extends his research. Furthermore, this study is carried out in a very specific context.
Summarizing, it could be stated that this is a contribution to science, while the designed generic open innovation business model is a model which described theoretical linkages from individual business model aspects to open innovation principles. For some business model aspects specific contributions could be presented, like value added resellers (VAR’s) stimulate open innovation, or that making use of licenses is a good revenue model for open innovation. Another example is that most of the (open) innovative companies out of the space-sector had close mutual contacts. This is a contribution to the open innovation literature; hence there was no real consensus of what type of partnerships is better for open innovation. Finally, evidence was found that use of indirect distribution channels makes companies less motivated to set up relationships with the end customers. This is a different finding than the status quo in the literature, but it might be caused by the fact that "the end customer" in the space sector is hard to define.

6.2.2 Practical contributions
This study has made practical contributions, which are relevant for SME’s in the Dutch space-sector and for the ESA as coordinating agency. The SME’s in the Netherlands could benefit by the generic open innovation business model, while they now have concrete handles how they could arrange their business model. Besides this, it helps the companies think about their model, because for most of the practitioners, a business model was just ‘a way how they earn their money’. The extensiveness in this model makes them think and readjust their current way of working. Seen the fact that it is very hard for these companies to select the right aspects of their model, several alternative configurations of the model were preset. Customer orientation, exploiting innovation, and network orientation are the three configurations that were made in order to use specific parts of the business model that seem to have linkages. Furthermore, CIMO principles are set up for the entire sector, so that the sector as a whole could work more towards outbound open innovation. The study hands different methods and tools to them how they can stimulate outbound open innovation. It also contributes by means of specific guidelines for the ESA, EC and Dutch government. These recommendations should be as guidelines on what can be done in order to get the SME’s from space and other sectors more involved in their daily operations. This would lead to more open innovation and finally to innovation in key enabling technologies.

6.3 Limitations
The conclusions and relevance of this study have to be interpreted in the right perspective. This study is subject to some insurmountable limitations, which will be discussed in this section. First, there is a limitation regarding the generic open innovation business model. This model is mainly based on theory and twenty interviews. The different aspects which are assumed to be linked to open innovation are not empirically tested on a large scale. This is counteracted by a testing study among four practitioners to minimize this risk. Second, the generalizability of this research is limited, because it is carried out in a space context, which is a very unique industry if you compared it to other markets. This study only looked at Dutch space companies. The special circumstances in this market (technological, SME’s, start-ups, georeturn, ESA tenders) make it difficult to generalize. The fact that the sector is so unique makes the internal validity higher. Third, interviews have been taken with different stakeholders, which might cause a CEO to give different answers, than a marketing manager. This could have led to biased data. Interviewees might also have cognitive limitations since they do not have the knowledge about the topic as the interviewer. This is mostly the case at SME’s while the CEO should have the knowledge about all aspects of the company. They might also show
tendency to give socially desirable answers. Fourth, time constraints made that just the generic open innovations business model was tested at four companies. The guidelines/design principles for the ESA, EC and the Dutch government were not inspected by practitioners and are less empirically grounded than the generic open innovation business model. Fifth, not all companies in the Dutch space-sector were interviewed, which makes the current subset not represents the whole space sector. About half of the companies that are active in this market were interviewed, but it misses the largest company Dutch Space. Sixth, time did also limit the implementation of this model. To make the whole picture complete, an implementation plan should be made in order to see what change management should be applied for successful implementation. The seventh and final limitation is that this study only focused on space companies, the ESA and some governmental institutes. The EC was left out and more government related interviews should be carried out in order to get a complete picture. This was done this way, because the Netherlands has no space agency as a country, which makes the ESA the dominant agency.

6.4 Suggestions for further research
Six areas could be investigated for further research based on this thesis. The first one is that the design principles should be empirically tested in order to have a stronger model. This could be combines with a further study on inbound and outbound innovation. Secondly the generic open innovation business model should be extensively tested in practice, while this happened only at for different companies. Thirdly, further research could investigate the alternative configurations of the business models. Researchers could look at if there are more alternatives, and when what type of companies should use a certain alternative configuration. If this is manager dependent, or just on company features that determine the alternative. Even market dependent characteristics might play a role. Fourthly, if the generic open innovation business model should be implemented in a company, these companies should have a strategy for implementation. This implementation plan, which also deals with change management, is another interesting area for research. What capacities and competences should the management have to guide this in the right track? The fifth direction for redesign is if the generic open innovation business is also applicable in other industries besides the space-sector. If you look at the space sector, it has very unique characteristics. Interesting would be to look if other sectors also like the model, and if other sectors prefer other alternatives. A sixth and final area for further research would be to look at incentives for outbound open innovation. A main conclusion from this study is that space should look more at opportunities in outbound open innovation, but this shows no direct revenue for the company active in outbound open innovation. Interesting would be to look at incentives for outbound open innovation.
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Appendix I Osterwalder (2003) Business model

Osterwalder Business Models

Figure 11 Business model Osterwalder (2003)
## Appendix II Coding Scheme

<table>
<thead>
<tr>
<th>Concept</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business model</strong></td>
<td>‘A business model is the bundle of specific activities that are conducted to satisfy the perceived needs of the market, along with the specification of the parties that conduct these activities (i.e., the focal firm and/or its partners), and how these activities are linked to each other’ (Amit and Zott, 2010)</td>
</tr>
<tr>
<td><strong>Open innovation</strong></td>
<td>‘Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively.’ (Chesbrough, 2006)</td>
</tr>
<tr>
<td><strong>Value proposition</strong></td>
<td>‘A value proposition is an overall view of a company’s bundle of products and services that are of value to the customer’ (Osterwalder, 2004)</td>
</tr>
<tr>
<td><strong>Operational excellence</strong></td>
<td>‘Providing customers with reliable products or services at competitive prices and delivered with minimal difficulty or inconvenience’ (Tallon, 2008).‖</td>
</tr>
<tr>
<td><strong>Customer intimacy</strong></td>
<td>‘Segmenting and targeting markets precisely and then tailoring offerings to match exactly the demands of those niches’ (Tallon, 2008)</td>
</tr>
<tr>
<td><strong>Product leadership</strong></td>
<td>‘Focusing on the products and services and continuously improving these products/services, to make the best for the customer’ (Tallon, 2008)</td>
</tr>
<tr>
<td><strong>Target customer</strong></td>
<td>‘The target customer is a segment of customers a company wants to offer value to’ (Osterwalder, 2004)</td>
</tr>
<tr>
<td><strong>Distribution channel</strong></td>
<td>‘A distribution channel is a means of getting in touch with the customer’ (Osterwalder, 2004)</td>
</tr>
</tbody>
</table>

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56
| **VAR** | ‘A value-added reseller (VAR) is a company that adds value, by means of features or other improved aspects on the products or service, and then distributed it to the end customer’ (Chesbrough, 2006) |
| **Customer relationship** | ‘The customer relationship describes the kind of link a company establishes between itself and the customer’ (Osterwalder, 2004) |
| **Key activities** | ‘A key activity or core capability is the ability to execute a repeatable pattern of actions that is necessary in order to create value for the customer’ (Osterwalder, 2004) |
| **Key resources** | Most important resources a company uses to add value to the product or service |
| **Key partnership** | A partnership is a voluntarily initiated cooperative agreement between two or more companies in order to create value for the customer (Osterwalder, 2004, pg 43) |
| **Closeness** | Contacts that you regularly have contact with |
| **Weak ties** | Contacts that you seldom have contact with |
| **Structural holes** | ‘Relationships of non-redundancy between two contacts’ (Burt, 1992) |
| **Cost structure** | ‘The cost structure is the representation in money of all the means employed in the business model’ (Osterwalder, 2004) |
| **Revenue model** | ‘The revenue model describes the way a company makes money through a variety of revenue flows’ (Osterwalder, 2004) |
| **Patent** | ‘A patent is a legal title granting its holder the exclusive right to make use of an intervention for a limited area and time by stopping others’ |
from, among other things, making using or selling it without authorization’ (Grandstrand, 2000)

<table>
<thead>
<tr>
<th>Licensing</th>
<th>‘Licensing is the entitled use of the patent, by paying a fee to the licensor’ (Grandstrand, 2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business model innovation</td>
<td>‘Business model innovation is a continuous process which involves designing a modified or new activity system, and it relies on recombining the existing resources of a firm and its partners, and it does not require significant investments in R&amp;D’ (Amit and Zott, 2010)</td>
</tr>
<tr>
<td>Political</td>
<td>Government regulations/interventions into the sector</td>
</tr>
<tr>
<td>Economical</td>
<td>Economic factors include all business and economy related factors in the sector</td>
</tr>
<tr>
<td>Social</td>
<td>Social factors include culture of the firm and other social issues that might influence daily business in a company</td>
</tr>
<tr>
<td>Technological</td>
<td>Technological factors deal with technological aspects like R&amp;D and technological development/change</td>
</tr>
<tr>
<td>Ecological</td>
<td>Environmental factors deal with environmental and ecological factors that might influence the business</td>
</tr>
<tr>
<td>Legal</td>
<td>Legal factors include law issues and regulatory issues that could influence business at the company</td>
</tr>
<tr>
<td>Cognitive</td>
<td>‘Cognitive routines make engineers and designers look in particular directions’ Geels</td>
</tr>
<tr>
<td>STI Indicators</td>
<td>Indicators of science, technology and innovation (STI) (freeman, pg 1)</td>
</tr>
<tr>
<td>Input Indicators</td>
<td>Indicators that measure the input effort in innovation and R&amp;D</td>
</tr>
<tr>
<td>Output indicators</td>
<td>Indicators that measure the</td>
</tr>
<tr>
<td>output result in innovation and R&amp;D</td>
<td></td>
</tr>
</tbody>
</table>

Table 7 Coding scheme
Appendix III Internal analysis

III.1 Value proposition
The first aspect that is investigated is the value proposition of companies, and specifically what value they bring in open innovation projects. Interviews have shown that the smaller space companies often focus on product leadership. They have a certain technology or production technology they possess and this technology is brought to the open innovation project. It is illustrated by the following two quotes.

CEO of a small space company: ‘Value proposition is mainly based on technology, because our technology is unique in the world and just a limited number of companies are capable of doing what we can’.

Head of R&D of a space company: ‘In space you need to focus on high end, so the top of the bill, making the best products which only a few companies can do.’

Larger space companies and non-space-sector companies are focusing on different values. Some larger space companies try to focus on customer intimacy, mainly the ones that have commercial aspirations. Companies that are not working in the space-sector try to bring in a mix of their values in open innovation projects. An illustrative example what should up in interviews was that these companies mentioned to bring in the best of all worlds, but with a specific eye towards customer intimacy.

Head of technology of a medium sizes non-space company: Our business model is based on customer intimacy as you might have noticed during my story. The value we add is mainly quality based, but the quality must be preset by the customer.’

Head of research department of a large non-space company: The value proposition is mainly based on the customer. If the customer wants lower throughput times or other specification this is the most important focus area for our company.

This fits with the research of Tallon (2008), while he states that companies should possess different values in order to maximize their added value to the product of service. These findings are complemented by the research of Chesbrough (2006), who mentioned that focusing on technology and solely improving the quality of their products this is disastrous for open innovation. This is supported by this empirically evidence from the interviews, which are graphically represented in table 8. Concluding you can state that most of the smaller space companies do focus on product leadership, because they possess a technology that they want to put in many markets. You see that space is a market that techno start-ups really want to explore to try their technology on. The non-space companies differ more in value proposition, while they are more focused towards the customer.
### III.2 Target Customer

Target customers do not really differ from industry and larger and smaller space companies. The goal of this question was to find out whether there was a different between companies in and out of the space-sector if they prefer working with partners that are focussing on the same target market, or do prefer working with partners that have access to other segments of the markets. Literature analysis did not show any indications of open innovation as an outcome of specific targeting of customers, which is supported by empirical evidence. There was no clear distinction between companies if they work with partner within the same sector of that they were mainly active in different sectors.

R&D manager at major research institution: ‘We focus on companies that have been active for a longer time in the space. This is because Space is very institutional, which means that certain companies and knowledge institutes have a lot of political connections’.

Marketing manager space at space research institution: ‘We try to work with companies that have been for a longer period in to the space, because they know how to access resources.’

What did showed up is that research centers focus mainly on working with companies that are focusing on the space-sector. After all you cannot find a major difference in the target customer between space companies and companies that are not working in the space-sector.

<table>
<thead>
<tr>
<th>Space</th>
<th>Value Proposition</th>
<th>Non-space</th>
<th>Value Proposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space 1</td>
<td>Product Leadership</td>
<td>Non-space 1</td>
<td>Operational Excellence</td>
</tr>
<tr>
<td>Space 2</td>
<td>Customer Intimacy</td>
<td>Non-space 2</td>
<td>Product Leadership</td>
</tr>
<tr>
<td>Space 3</td>
<td>Product Leadership</td>
<td>Non-space 3</td>
<td>Operational Excellence</td>
</tr>
<tr>
<td>Space 4</td>
<td>Product Leadership</td>
<td>Non-space 4</td>
<td>Customer Intimacy</td>
</tr>
<tr>
<td>Space 5</td>
<td>Customer Intimacy</td>
<td>Non-space 5</td>
<td>Customer Intimacy</td>
</tr>
<tr>
<td>Space 6</td>
<td>Customer Intimacy</td>
<td>Non-space 6</td>
<td>Operational Excellence</td>
</tr>
<tr>
<td>Space 7</td>
<td>Product Leadership</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 8</td>
<td>Customer Intimacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 9</td>
<td>Operational Excellence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 10</td>
<td>Product Leadership</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 11</td>
<td>Combination of all three</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Value propositions of space an non-space companies
III.3 Distribution Channel

The section distribution channels compares what types of distribution channels are used at companies in their shared innovation projects. Larger Non-space companies were distributing their products directly to the end customer, but in the last years they were switching towards indirect distribution channels. Literature showed that there is one type of distribution channel that fits very well for open innovation, while this type of distribution channel causes a dependency relation on its self. This is the Value Added Reseller (VAR). Interviews showed differences between space and non-space companies. Most of the companies that are not working in the space-sector use direct distribution channels, while non-space companies do use indirect channels and VAR more often (see table 9). This might come because of the fact that companies stated that you have to work together into space to do business. Four companies were analyzed into further depth to give an illustration of what type of distribution channels they use.

Founder of space company and CEO of that same space company: ‘You need to work together in space otherwise you can do any projects together’.

They sold their product to a large company in space industry which further adapts the project to make it ready to test products into space. It means that their partner to whom they have sold their product works further on the project and adapts it to make it better.

Co-founder and CEO of a high tech space start-up: ‘The company sell their antenna’s products to other companies which implement their antenna’s in their products to make it useful for commercial business.’

This company sells their antenna technology to larger companies which use it for example on trains or airplanes after the further modified the product. They sell their technology most of the time to larger companies which can make an actual useful product with their technology.

R&D employee: ‘Distribution is not done via VAR, because we sell directly to the customer. This causes our company to stay close to the wishes of the customer.’

At this company, which is working in the coating industry, value added resellers are not used. Their value proposition is aimed at satisfying the customers, and they want to stay close to the customer, without the interference of another company. That is why this non-space company does not want to work with VAR’s.

R&D employee of a non-space company: ‘We don’t use VAR, just our own distribution channels, while we want to keep our technology in house.’

This company is very protective, while they do not want a competitor to show their technology. They want to keep everything inside, and that is why they sell a company ready-to-use product towards their customers. They do not need any one else to see what they have and use their direct distribution channel as a protective matter. All products are directly distributed to the end customer.

Finally distributions channels were investigated on their operational use in shared innovation projects. According to the research if new distribution channels were set up or old distribution were being used in innovation projects no concrete results were found. No real difference should be detected in the interviews. Literature showed that is better to use multiple distribution channels to
avoid sunk costs, but empirically evidence did not show any leads to back up this theory. An example of multiple distribution channels is when a certain company uses different channels to sell their products. All companies stated that they just use one type of distribution channel as a main channel. Some companies, in out of the space-sector mentioned that sometimes new channels are set up but only if they need to explore new markets. Concluding you can state that space companies make more use of VAR’s, because they have to work together to make their technology applicable in a useful product. Larger companies that are not working in the space-sector try to protect their technology and are better capable of delivering a complete product towards the final customers.

<table>
<thead>
<tr>
<th>Space</th>
<th>Distribution Channel</th>
<th>Non-space</th>
<th>Distribution Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space 1</td>
<td>Direct</td>
<td>Non-space 1</td>
<td>Direct</td>
</tr>
<tr>
<td>Space 2</td>
<td>Indirect (VAR)</td>
<td>Non-space 2</td>
<td>Indirect (no VAR)</td>
</tr>
<tr>
<td>Space 3</td>
<td>Indirect (VAR)</td>
<td>Non-space 3</td>
<td>Direct</td>
</tr>
<tr>
<td>Space 4</td>
<td>Indirect (VAR)</td>
<td>Non-space 4</td>
<td>Direct</td>
</tr>
<tr>
<td>Space 5</td>
<td>Indirect (VAR)</td>
<td>Non-space 5</td>
<td>Direct</td>
</tr>
<tr>
<td>Space 6</td>
<td>Indirect (VAR)</td>
<td>Non-space 6</td>
<td>Both</td>
</tr>
<tr>
<td>Space 7</td>
<td>Indirect (VAR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 8</td>
<td>Indirect (VAR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 9</td>
<td>Both</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 10</td>
<td>Both (VAR/Integrator)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 11</td>
<td>Direct</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9. Distribution channels

III.4 Customer relationships

Customer relationships tried to investigate three different things. Firstly if there were any methods tools or strategies to enhance the relation with your customer. Empirical evidence showed that companies that have their value proposition directed to customer intimacy use tools and methods to enhance customer relationships. The following two quotes are from companies that have their value proposition focussed towards customer intimacy.

Account manager space: ‘We have developed a web tool so we can make drawings and exchange them without partners, so we know the wishes of the customer and are able to talk with them.’

Marketing manager of a space company: We have a system which is used as ERP system, with an integrated CRM Tool, so we can keep track of the wishes of the customers.’

Smaller companies that are active in the space, or are very new in the market do set up customer relationships yet, because they are busy working on their technology. Interviews showed that the companies with a product leadership value proposition do not often use CRM tools.

Founder and CEO of space company: ‘Customer relations are not set up at this moment, while they think of flying in over 3 years. This is for later moments.’
Co-Founder and CEO of space company: ‘We are still in the innovation phase, working on the research programme’s, so this has no priority for us. We only use our contacts to create a network during our R&D phase.’

Companies that want to work together should have the same customers, in order to create the best synergetic advantage. An example to build up a customer relation is by the means of using customer relationship management software (CRM), which is often used at larger companies that do focus on the needs of the customer. If the value proposition was more focused on customer intimacy you see that tools are preferred above personal contact. Secondly partner selection was looked at. None of the interviews showed evidence that selection criteria were used when companies should select a partner for collaboration. Some larger companies do work with CRM software and try to set up shared tools within the relationship, but they don’t use the tools for selection. Smaller SME’s in the space do not us any tools to enhance the relationship with the customer. None of the interviews mentioned criteria for partner selection. Thirdly this section looks at how companies take the risk into account, of letting partners come close to their customers. The larger companies in and out of space and all research institutes have affinity with non-disclosure agreements. Sometimes collaborations are not entered if the partner should come to close to the technology. Smaller space companies do not have any experience with this problem. At three small space companies they mentioned that if larger companies put enough effort in getting their technology, they get it anyways, because of their resources.

III.5 Key activities
The section key activities describes the empirical findings of the key activities of companies. The focus mainly was on if the key activities were internally or externally oriented and if they were complementary or not. Activities that were more outside oriented were better for achieving open innovation as was stated in the literature. No difference between space companies and non-space companies was found. From the eleven space companies, six companies/institutes mentioned to have a more external oriented focus of their key activities. This is exactly half of the interviewed space companies. In the non-space-sector six interviews are conducted and four interviewees mentioned that their company has an internal focus of their key activities. When looking to the complementarity of the activities, all interviewed companies stated that they want to work together with a partner which possesses different capabilities than the core capabilities of their company. In conclusion you can state that was no clear difference between space and non-space companies looking at the way they organize their key activities, which the literature already suggested.

III.6 Key Resources
The aspect ‘key resources’ is the next part of the business model which was investigated. Two main points of interest were empirically investigated. The first point of interest was if companies focus on complementary resources, or resources that are similar to the resources of the company. All companies told that, in shared innovation project, they prefer to work with partners that possess difference resources. An interesting fact that arose during the analysis of the use of key resources was that, companies in space really wanted to work together with companies or institutes that possess knowledge which is hard to have as small company in the market.
R&D employee space company: ‘The most important resource we possess is a diverse machine field with state of the art capabilities. For space you need high quality machines, and a high quality level, which is unique for this sector.’

Head of technology space company: ‘In some cases some key facilities are important assets to have access to (e.g. ESA operates some unique satellite test facilities in Europe).’

A second area of interest was the use of open source software. Literature indicated evidence for the benefits of open source software for open innovation. Just one single company indicated that they make use of such a tool, and this was a company active in the space and aerospace industry. This is shown in the following quote.

Account manager space: ‘We have developed a web tool so we can make drawings and exchange them without partners, so we know the wishes of the customer and are able to talk with them.’

Concluding you can state that key resources from space and non-space companies are not really different. An interesting point showed up in the empirical analysis that space companies really want to work together with other companies or institutes with certain resources in the space-sector.

III.7 Partnerships
A partnership was the following aspect of interest. Literature showed that it might differ how the contact relation with the partner is if you want to achieve open innovation. Two different classes were made to distinguish the frequency of contact. If the partners had weekly contact or even more often this was often described as close contacts. If the frequency of contact exceeded this period of one week, than it was classified as a weak contact. The final category was brokerage, which means making use of a broker position to get partnerships. Most of the companies, in or out of the space-sector had close contacts.

Business developer space: ‘Partnership with ***** consists out of 2 partners, every week we talked together.’

R&D employee of a non-space company: ‘Most of the times there is a collaboration with one partner, and it can vary from two to three partner with daily contact.’

Larger companies did mentioned that it really depends on the phase where the project is in, but that this was an average of the contact frequency. A further area of investigation was if companies often work together. This did show a difference between space and non-space companies.

Head of R&D of a space company: ‘It depends on the phase of the project, if you work in a very intensive phase it can be weekly, or even multiple times in a week.’

Product specialist of a non-space company: ‘Mainly dependent on the type of project, sometimes once a week, but project dependent it can be a few times in a week, dependent on the phase where the project is in.’
During the interviews space companies said to do a lot of innovation with partners. Larger non-space companies stressed the importance of open innovation, but stated to do a lot of research in house. A representative quote is given, what could be seen as a general tendency in space companies.

CEO and co-founder of a space company: ‘You can’t work alone in this space business, so you to work together to bring in subsidies and work as a consortium to tender for the different space projects.

CEO and founder of a space company:’ Partnerships are necessary for our company, otherwise we can’t do anything in the space-sector.’

CEO and founder of a space company:’ Intensive collaboration is needed, because in this world it isn’t possible to possess the knowledge of each individual important part.’

Concluding you can state that space companies have more partnerships to do innovation with, because they have to work together in order to business in the space-sector. Furthermore the type of partnerships does not differ for in and out of the space-sector. Finally you can see that larger companies divide projects into phases and base their contact frequency more often on the project phase. Table 10 gives an overview of all different companies.

<table>
<thead>
<tr>
<th>Space</th>
<th># partners relationship</th>
<th>Non-space</th>
<th># partners relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space 1</td>
<td>1 Close</td>
<td>Non-space 1</td>
<td>1/2 Close</td>
</tr>
<tr>
<td>Space 2</td>
<td>2/3 Close</td>
<td>Non-space 2</td>
<td>2/3 Close</td>
</tr>
<tr>
<td>Space 3</td>
<td>2 Close</td>
<td>Non-space 3</td>
<td>7 Weak</td>
</tr>
<tr>
<td>Space 4</td>
<td>2 Close</td>
<td>Non-space 4</td>
<td>1/2 Close</td>
</tr>
<tr>
<td>Space 5</td>
<td>2/3 Close</td>
<td>Non-space 5</td>
<td>4 Close</td>
</tr>
<tr>
<td>Space 6</td>
<td>3 Close</td>
<td>Non-space 6</td>
<td>2 Close</td>
</tr>
<tr>
<td>Space 7</td>
<td>1 Weak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 8</td>
<td>2 Weak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 9</td>
<td>3 Close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 10</td>
<td>2 Close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space 11</td>
<td>3 Close</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10. Relationship types
III.8 Cost structure

Cost structure was the following aspect to be looked at. Literature showed that advantages for open innovation can be gained by sharing the research and development cost. This was the only point of interest found in the literature which showed that differences might be present to achieve more open innovation looking at cost structure. Furthermore there is no specific type of cost structure found that showed evidence of being important for open innovation. Some examples of costs at different companies are represented by the following quotes.

R&D manager of a non-space company: ‘Costs are allocated via project number, and every man hour and raw material are allocated to this projects.’

Product specialist of a non-space company: ‘Our company sees R&D as Costs, because the revenue is not quantifiable.’

Business developer space: ‘Costs are shared in projects, by the means of input in the project.’

This is backed up by empirical evidence from the literature. As final remark could be noticed that no specific cost structure was often mentioned, or related to open innovation. Most of the companies told that the way how the subsidy is organized depended how the costs were allocated. But that this was very different for every project as mentioned by all the companies. No difference was found between space and non-space companies.

III.9 Revenue model

The last part of the business model is looked at way how a company’s makes revenue in their open innovation projects. A first question asked was how the main revenue was generated and what percentage of the company’s revenue was gained through partnership/alliances/open innovation. Space companies admitted that they get more revenue through open innovation, but the percentages were different for every different company. There was no clear difference between space and non-space companies. The second area of interest was if the company did something with patents and licenses. Here a difference between space and non-space companies was present. Companies that were working outside the space-sector showed that they see benefits of patents and licenses, mainly to project their technology as is represented by the following quotes.

R&D employee of a non-space company: ‘We do use patents, mainly to protect our technology’

Head of engineering of a non-space company: ‘Patents are being used, mainly to project our technology, but not to make money out of it.’

More than half of the companies outside the space-sector did open innovation projects with the use and help of patents and licenses. A few space companies said to have experiences with it, but the tone was less positive than the non-space companies. These were the bigger companies in the space-sector. The smaller space companies said explicitly that they do not want to work with patents and licenses. The general tendency was that they say that if larger companies are interested in their technology they would get it anyways. Larger companies possess resources that they could use to get the technology anyways. That was the reason for most of the smaller space companies not to use the technology by means of licenses and patents.
Account manager space: ‘Protection by means of patents if not viable for us, it is better to just protect the technology and keep it in house’.

CEO and founder of a space company: ‘We’ve drawn a conclusion that patents are only useful for us when you come problems and that you want to sell yourself to another company.’

Marketing manager space: ‘We do not use patents, because our philosophy is that the industry much utilize the technology.’

They do have another way to use it, which is called protection. If they have a technology that they don’t want to show others, they just cover it of the market. Literature states that this is not good for open innovation, because they technology sharing aspect disappears.
Appendix IV  External analysis

IV.1  Political
The first external factor that is being analyzed is the political situation. More specifically how the current political situation fosters or inhibit the collaboration with partners for shared R&D. Smaller space companies are not amused with the current political situation. The whole sector agrees that budgets are being cut down and the most important subsidy rule PEP is being cut by thirty per cent, which makes it more difficult to get governmental support for innovation activities. Others tried to look at it from the bright site; hence (Aero) space is one of the focus areas of the Dutch government. Companies react to this by making choices, and focussing more specifically on one or a few project instead of their whole portfolio.

R&D employee of a non-space company: ‘The innovation budgets in going down, due to political decisions.’

Business developer space:’ Political budget ‘factors inhibit the innovation projects in the economic crisis now.

CEO of a space company:’ We keep the lower R&D budgets in our mind, by looking at the ESA’s areas of interests and try to adjust their research direction to it.’

Smaller SME’s from the space-sector did ventilate some remarkable observations. In their opinion the funding is very political, which in their vision means that the money flows to the government oriented companies. Some companies that are longer in the space market get easier access to funding and subsidies according to the start-ups and SME’s in the space-sector. They state that the ESA’s policy is directed more towards conventional larger firms, which makes it hard for them to compete in the market.

CEO and founder of a space company: ‘The economic crisis caused politicians to cut the funding budgets. EU is giving money to the ESA, ESA gives it back to government driven companies or institutes.’

Most of the companies that were interviewed were working with (scientific) research institutes to test or co-develop their product. There was no difference between space and non-space companies regarding this topic. The companies see the value of these institutes and try to make use of them.

Product specialist of a non-space company: ‘It is important to work together with universities. R&D funding needs to be there, nowadays you see that institutes need the flow on money although these economic times.’

IV.2  Economical
According to the economical part of the external environment the main investigation topic was if the company is capable to change their business model often. And if they are not capable of changing this model if that is because of financial reasons. Some companies told that they have to invest a lot of money because their organization is already working a longer period of time via a certain way. Others state that this is no problem for them, because they are very flexible and they are capable to react to changes in a volatile environment. More specialization is an often mentioned aspect of
reacting to certain changes in the market. It is really company dependent if they think they are capable for handling such changes. This was really company dependent, so no clear remarkable empirical conclusions were present. Concluding you can state that it depended on the nature of the company if they are capable for changes.

IV.3 Social
Some companies showed that they are socially capable to change or adapt their business model frequently. An important aspect mentioned is if they have a lot of flexible hours. This is mentioned several times as being a factor of being capable to socially responsible change business models. What did showed up is that there is almost no persistence to change when the business model is innovated, if they arranged the company with flexible hours.

R&D employee of a non-space company: ‘Socially we have 30% flex places and 70% full time jobs, so we can socially responsible react to changes in the demand.’

Innovation manager of a non-space company: ‘Most of the employees are socially capable of handling business model changed, some employees who are longer employed at the company find it hard to go such a changing process.’

Some states that personnel that is working longer at a firm needed some adaptation time, but most of the times this was not seen as a problem on longer term. Finally an aspect that was looked at was if there was space for innovation or changing the business mode if some good ideas showed up. Most of the interviewees were not able to answer this question, but the ones that did answer showed that there is always room for good ideas in a company.

IV.4 Technological
The technological aspect is focused on how companies deal with research funding. Space and non-space companies both worked with research funding. Larger non-space companies were more professionally working with it; hence they have departments that focus on getting in funding for technological research. Space companies are very dependent on funding and that is why they are really focussing on it.

Marketing manager space: ‘ We get 25 % of our revenue from the government.’

CEO and founder of a space company : ‘ We as a company applied for three national subsidy proposals and luckily succeed all of them.’

Furthermore the technology questions investigated how intellectual property rights and copyright infringements foster or inhibit partnership R&D. There was a difference present between space and non-space companies. The smaller space companies states that it inhibits the innovative capabilities if a company protects the technology. Some space companies stated that when they want to protect technologies it costs a lot of money which makes less money available for other innovations. Larger non-space companies stressed on the fact that technology protection has both positive and negative sides. All companies stated that the use of protective measures should be dealt with in a very careful manner.
IV.6 Legal
According to the legal issues space and non-space companies were questioned on if they are restricted by regulations (law) often, with the focus on open innovation and partnerships. The main focus was to find out of legal issues inhibit the partnership processes. And if changes should be made to make collaborations easier. After the interviews it seems that almost none of the company showed that anything should change regarding the legal issues to foster open innovation.

R&D employee of a non-space company: ‘Laws are rules do not make business harder.’

R&D manager of a non-space company: ‘Laws that inhibit the collaborative innovation are not really present, although some prescriptions about new technology use are vague.’

CEO and founder of a space company: ‘Laws and rule do not have a lot of influence on shared innovation.’

The ESA stated that on the European level this could be improved as can be seen in the quote underneath. Although Dutch companies, in and out of the space-sector did not show any reasons to changes laws and rules to foster open innovation.

Head of technology at ESA: ‘A better legal frame that is more “collaboration oriented” would certainly be better. However, competitiveness of European space industry must also be protected’

IV.7 Ecological
The last part of this external analysis focuses on the ecological factors that could play a role. Many space companies stressed the fact that space has an environment unfriendly attitude, which makes ecological aspects hard to do business. Almost all companies mentioned that attitudes to the environment from the government play a role in their daily business, but that it not has an impact on partnerships. Some non-space companies mentioned that they made policy of working with other partners regarding their environmental friendliness, but this wasn’t done often. All space companies and institutes state that they can use ecological aspect for their business to promote space.

R&D manager of a non-space company: ‘Ecological factors play a large role on R&D. Sustainability is own of the key factors of the company, so task forces are internally focusing on sustainably building technologies. It seems as a huge chance for the company.’

Business developer of a non-space company: ‘Ecological factors provide huge opportunities, for reducing emissions.’

Account manager space: ‘Even our customers and suppliers need to have a certain ecological standard, hence they have to stick to the REACH treatment’.

Off course they see some difficulties regarding different rules, but if they had to make a choice between seeing ecological factors in space as a chance of a threat, all of them answered that ecological factors are chances for more business and promoting their company.
Appendix V  Business model redesign

V.1 Value proposition
Literature showed that there are three main value propositions, namely operational excellence, customer intimacy and product leadership. Literature suggested that product leadership wasn’t the right choice for open innovation, while the focus would be just on the quality of the internal product. Interviews have supported this fact, hence small space companies focus more on technology, while companies that are known to be very innovative focus more the customer relation. The non-space companies differ more in value proposition, but are more focused towards the customer. Three main conclusions can be drawn from the interviews and the literature.

- Companies should not solely focus on product leadership.
- Companies should try to direct their value proposition towards the customer.
- In open innovation complementary values should be brought together to reach maximum advantage.

V.2 Target customer
The target customer was defined as a segment of customers a company wants to offer value to. Literature analysis did not show any indications of open innovation as an outcome of specific targeting of customers. Empirical evidence did not show a major difference in the target customer between space companies and companies that are not working in the space-sector. Literature indicated that different companies focus on the same target customer in order to achieve something together might be partners and competitors at the same time. Larger companies told that this might occur and advised to careful assess your open innovation partners when is working with the same target customers.

- When working together with an open innovation partner that is working with the same target customer, you must be careful with the information you give to them. Contracts, non-disclosure forms, and other legal instrument might help.

V.3 Distribution channel
Literature mentioned two main types of distribution channels. The first type is direct distribution, which means the direct delivery from the product to the end customer. An example is selling via internet, or insurance policies. The second type is called indirect distribution, which means that there is another company between the company and the end user. In the last category there is one type of distribution channels which fits very well for open innovation, namely the value added reseller. Space companies did work with VAR’s, because most of the space projects are done with multiple partners. Furthermore most of the space projects are so large that they have to cross many companies before reaching the end customer. This is why space companies are very familiar with open innovation projects. Another aspect of the distribution channel is if a company should set up a new distribution channel or combine the existing channels. Literature showed that is better to use multiple distribution channels to avoid sunk costs, but empirically evidence did not show any leads to back up this theory. Two main conclusions can be drawn from this study.
• Companies should try to make of Value Added Resellers in order to get more benefits from open innovation.
• Companies should try to make use of several distribution channels to avoid sunk cost and to enlarge their network.

V.4 Customer relationship
Literature showed that if companies want to work together in an open innovation setting they the company they work with should have the same customers. This would be necessary in order to create the best synergetic advantage. Some scholars also suggested building up a customer relation by the means of using customer relationship management software (CRM). Empirical evidence showed that these tools were used if the value proposition was directed towards customer intimacy. A combination of customer intimacy and CRM tools lead to a strong customer oriented innovation strategy which focused towards open innovation. If the value proposition was more focused on customer intimacy you see that tools are preferred above personal contact. Smaller SME’s in the space do not us any tools to enhance the relationship with the customer. None of the interviews mentioned criteria for partner selection. This leads to several recommendations.

• Companies should implement CRM tools in order to enhance the relationship with the customer.
• Companies should use criteria for partner selection in open innovation projects.

V.5 Key activities
Looking at the key activities of a company in relation to open innovation literature mentioned to if you focus the key activities too much on technology development activities solely, is fateful for open innovation. Activities that were more outside oriented were better for achieving open innovation as was stated in the literature. No difference between space companies and non-space companies was found. All interviewed companies stated that they want to work together with a partner which possesses different capabilities than the core capabilities of their company.

• Companies should not focus their key activities on technology development activities solely
• Companies should try to focus their key activities outside of the company

V.6 Key resources
Literature states that there must be a good balance between the internal and external resources; otherwise the resources might act as a substitute innovation source instead of complementary resource. Furthermore scholars investigated that the use of open source software might stimulate the activities in open innovation. The main vision behind the open source software is that it is, after creation available outside the firm boundaries. Companies could work together with this software in order to innovate together. An interesting point showed up in the empirical analysis that space companies really want to work together with other companies or institutes with certain resources in the space-sector.

• Companies should explore the use of open source software.
• Companies should use their resources to work together with companies and institutes outside the space-sector.
V.7 Partnerships
Scientific scholars showed no consensus how to create the best network in order to have the highest risk of success in open innovation activities. The theoretical framework differentiated three main types of partnerships, namely closure, brokerage and weak ties. All of them had theoretical and empirical evidence of being the best strategy for partnerships. Closure leads to a trustworthy environment. A trustworthy environment ensures the safety of the information. The second strength is that close networks are rich of people that have the same shared norms of behaviour. Empirical evidence showed that space companies have many partnerships with close ties, which is good for open innovation. Larger companies divide projects into phases and base their contact frequency more often on the project phase, which is also beneficial.

- Companies should have close contacts with their innovation partners.
- Companies should base their contact frequency on the project phase, where the open innovation trajectory is in.

V.8 Cost structure
Literature didn’t show many clues how cost structures could help companies to be more suitable for open innovation. Just some studies indicated that sharing cost of open innovation leads to the same focus area of the collaborating open innovation companies which is very beneficial for open innovation. Interviews don’t provide any evidence for a dominant cost structure that leads to open innovation. Companies do admit that sharing costs is important for collaborating in open innovation.

- Companies should share cost in open innovation projects which is company and project dependent.

V.9 Revenue model
The theoretical framework states that patents are good assets to protect your technology. In order to exploit these patents licenses could be used to make revenue from the patents. This can foster the collaboration between a party which possesses knowhow, and another party for whom the information is valuable. Open innovation can be stimulated if a party with the knowhow uses licenses so that another company can use that knowledge. Empirical evidence showed that more than half of the companies outside the space-sector did open innovation projects with the use and help of patents and licenses. Most of the space companies didn’t have experience with the use patents. The smaller space companies said explicitly that they do not want to work with patents and licenses, although this is recommended by literature.

- Companies should make use of patents to protect their technology.
- Companies should exploit their patents by means of licenses.
- Companies should explicitly make use of subsidies in open innovation projects.